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TACTICAL VEHICLE EVALUATION MODEL (TVEM)

STANLEY BUTLER
WAYNE FERGUSON

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U. S. ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY
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Support Mission	Travel Time
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Mission Transfer	Fleet Mix

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A computer model to compare tactical vehicle fleet mixes in an operational context has been adapted by the US Army Materiel Systems Analysis Activity (AMSAA) from a model developed at the US Army Transportation School. The Simulation, translated into FORTRAN IV, is described herein. Also included are the program listing, program narrative, test case input and output, and other detailed documentation.

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TACTICAL VEHICLE EVALUATION MODEL (TVEM)

1. INTRODUCTION

For several years, personnel in the US Army Materiel Systems Analysis Activity's (AMSAA's) Combat Support Division have recognized the need for a computerized simulation that can evaluate tactical vehicles in an operational sense. AMSAA has models that can perform engineering evaluations, i.e., models that can determine performance factors such as acceleration capability and speed over various road surfaces and terrain types given information about the vehicle's configuration, gear ratios, engine power, etc. However, AMSAA did not have a model that could combine these vehicle performance factors and cargo capacities with scenario-related information such as unit locations, movement schedules, and supply mission tonnages to describe the performance of vehicle fleet mixes. Just such a model was developed by the US Army Transportation School at Fort Eustis, Virginia, in support of the TACV Study.(1) AMSAA personnel obtained, for review, a copy of the model from the Transportation School in order to determine its adequacy for AMSAA's purposes. As a result of this review the model was judged to have some limitations, but, because of its simplicity compared to other transportation models, such as the Tactical Vehicle Fleet Simulation (TVFS) Model,(2) it was felt that the Transportation School Model would serve as an acceptable basic framework for an improved model.

The Transportation School Model was developed by Arthur W. Paarmann while he was employed there as an operations research analyst. Unfortunately, with the exception of Appendix D in the TACV Addendum,(3) little substantive documentation of the model existed and there were no operating instructions to assist potential model users. The model logic was coded in the BASIC language specifically for the Hewlett-Packard Model 9830A mini-computer. In order to fit the model into the memory storage available on that machine, Paarmann was forced to use various memory conserving techniques, among which was the transferal of program segments and large blocks of information back and

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1 Addendum To The Special Analysis Of Standard Tactical Wheeled Vehicle Requirements, (Short Title): TACV Addendum, Volume II: Main Report And Appendixes (sic) A Through J, US Army Training And Doctrine Commmand, August 1979.

2 Hudak, Paul E., Koenig, Lawrence D., and Swanson, George O., Documentation of the Tactical Vehicle Fleet Simulation Model, General Research Corporation, McLean, Virginia, May 1977.

3 Loc. Cit.

forth from central memory to mass storage files established on cassette tapes. Because AMSAA has no HP9830A mini-computers and in order to ensure freedom from restrictions on future expansion, the model was translated into FORTRAN IV for use on large main-frame computers such as the Ballistic Research Laboratories CDC CYBER 76.

The purpose of this report is to provide thorough documentation of the FORTRAN version of the model.

2. DISCUSSION

2.1 Model Description.

The purpose of the Tactical Vehicle Evaluation Model (TVEM) is to compare various fleet mixes in an operational context by providing a meaningful way of combining individual vehicle performance factors with scenario-related information. The vehicle fleet is organized into vehicle pools each of which consists of a specified number of vehicles operating from a given location. The vehicles in a given pool must be identical in terms of essential operating characteristics such as cargo capacity and travel speed. For each pool, a list of supply missions is specified. For each mission, the amount of cargo to be delivered and the time and day that the cargo must be hauled are specified as well as the route (called the link) on which the vehicles must travel in the performance of the mission. If the pool is authorized a higher echelon support pool to undertake the assigned mission in the event that it cannot be performed as scheduled, the number of the pool to which the mission can be transferred must be specified. To allow for the situation in which the pool would have enough vehicles available to haul only part of the cargo in the mission assignment, a parameter must be specified to indicate whether it is permissible to "split" the mission. Each route or link on which a mission is to be performed must specify the vehicle travel times, load and unload times, and various delay times.

The output of the model gives the simulation results by vehicle pool. The results consist of the number of missions completed, the number of assigned vehicles used, the percentage of unused vehicle capacity, and other measures of efficiency. At the user's option the model also produces graphs giving, in terms of percent of total assigned, tons of cargo delivered versus time and cubic feet of cargo delivered versus time. A third graph shows the number of vehicles in use over time.

The TVEM is an event-sequenced, not a time-incremented, simulation. Consequently, it makes little sense, for example, to inquire of the number of days of operations the model can simulate. Instead, the pertinent question is how many operations (missions) the model can process, and this is restricted only by the amount of memory space the model user can afford to devote to the number of missions per vehicle pool vis-a-vis the number of pools to be simulated. Table 1 gives the current program maxima. These limits can easily be increased by array enlargement whenever necessary. With the current limits, the program requires about 95,000 words of memory space of which approximately 83,000 words are directly addressable, large-core memory resident.

2.2 Model Assumptions.

Assumptions basic to the TVEM are the following.

(1) Each pool consists of a homogeneous set of vehicles. That is, their model-related characteristics such as cargo capacities, travel speeds, and load and unload times are the same.

(2) A mission is characterized by its weight and volume (or vehicle bed space), loading and unloading times, and delay times.

(3) The timing of each mission is specified by the vehicle departure time or the time that the cargo is required to be delivered to the using unit.

(4) Vehicles cannot be swapped between pools. If a pool has missions it cannot accomplish, support is effected by transferring the missions to a supporting pool, not by borrowing vehicles.

2.3 Model Inputs.

The information gathering process for determining the input data values to the TVEM requires that three distinct tasks be undertaken.

(1) Map exercises must be performed to determine the unit location and movements, vehicle resupply routes, and mission schedules.

Such map exercises are frequently an adjunct to a war game.

(2) A vehicle mobility model is used along with the information on the routes generated by the map exercises to determine vehicle speeds and, hence, the travel times on the routes.

(3) The payload tonnage and cubic capacity of the vehicles being evaluated must be determined.

Once the input information gathering tasks are completed, the information must be structured in the following form for each pool.

Table 1

TVEM Program Maxima

Vehicle Pools - Maximum number simulated - 10

Supply Missions - Maximum number per pool - 500[1]

Supply Routes or Links - Maximum number per pool - 100

Vehicle Types - Limited only by the number of pools

Number of Vehicles - Unlimited[2]

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[1] A warning message is printed if the maximum is exceeded because of mission transfers.

[2] To find the number of vehicles required to accomplish a given set of missions, one might wish to set the number of vehicles per pool to a very large number.

(1) The characteristics of the pool-

Pool identification number,

Vehicle type identification number,

Vehicle payload in short tons (X10),

Vehicle cubic capacity in cubic feet,

Number of vehicles in the pool.

The data entries for the preceding five items must be punched on one card in 5I5 format.

(2) Schedule of missions. For each mission the following information must be given -

Number of the link on which the mission is to occur,

Day the mission is to occur,

Vehicle departure time, or

Required delivery time,

Mission cargo tonnage in short tons (X10),

Mission cargo volume in cubic feet,

Number of the pool to which the mission can be transferred,

Parameter to indicate whether the mission can be split.

For each mission the preceding eight items must be punched on one card in 8F8.0 format with all decimal points punched. One card must be allotted to each mission and the list of missions must be terminated by a card having a negative number in the first field.

(3) Information on the links. For each link or route on which a mission is to occur, as specified in the schedule of missions, the following information must be supplied -

Link identification number,

Load time,

Travel times,

Unload time,

Mission delay times (times spent in various queues).

The values for each link must be punched on one card in 9F8.0 format with all decimal points punched. One card must be allotted to each link and this series of cards must be terminated by a card having a negative number in the first field.

For an example case to illustrate the structure of the missions and links arrays, refer to Appendix C.

The TVEM can simulate three types of missions: pickup, delivery, and support missions. Diagrams of these mission types are shown in Figures 1, 2, and 3, respectively. The model user represents these three types by various arrangements of the time entries in the links array. In particular, for a pickup mission the entry in field three must be zero, while that in field nine must be greater than zero. To simulate a delivery mission the reverse must be true, i.e., field nine must contain a zero. For a support mission, the values in fields three and nine must both be zero and the times to reload and return to the pool should be combined and entered in field eight. The distinctions between the three types of missions enable the model to properly reflect the fact that delivery of the mission cargo to the consuming unit may be concurrent with the return of the vehicles to the pool (pickup missions) or that the cargo delivery may be completed prior to the return of the vehicles (delivery or support missions). In the second case, although the mission is completed with the cargo delivery, the performing vehicles are not available for another mission until they return to the pool.

2.4 Overview of The Model Logic.

Figure 4 is a flowchart of the main simulation portion of the TVEM. The program subroutines which are concerned with input and output printing, graphing, mission sorting, etc. are not covered by this flowchart.

The TVEM processes each pool one-by-one for as many pools as have missions assigned to them. For a given pool, any missions transferred from previously processed pools are first appended to the list of missions originally assigned to it. The model then determines for each mission the time that the vehicles must depart and the time that the vehicles will return to the pool (and thus be available for another mission). These times are put into chronological order with an indication of whether each is a mission departure time or a return time, thus giving a time ordered list of mission events.

Next, the model processes each event in order. If the event is a return from a mission, the number of vehicles returning is added to the number of vehicles available, if any. On the other hand, if the event pertains to a required mission departure, the model calculates the number of vehicles required based on the mission tonnage

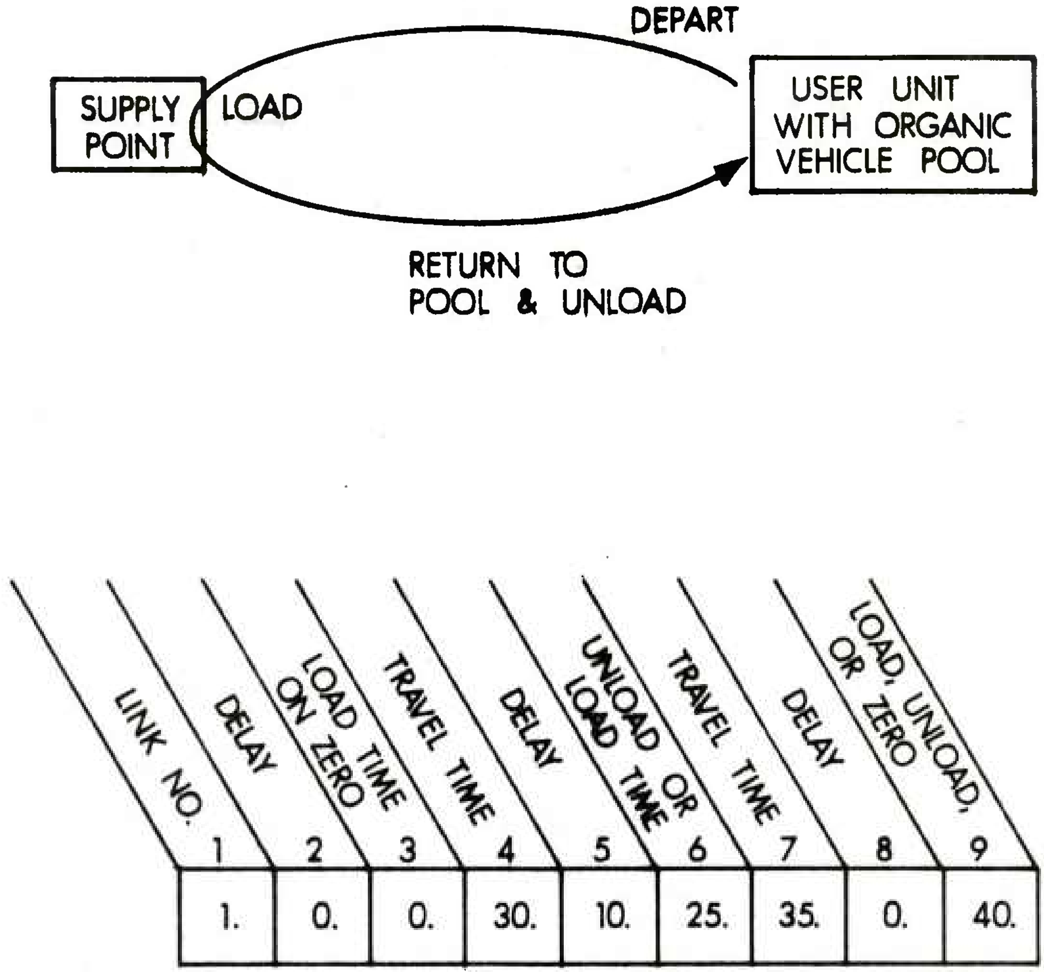
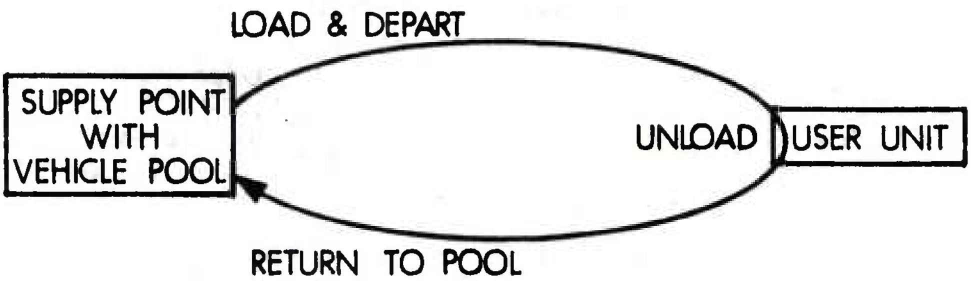
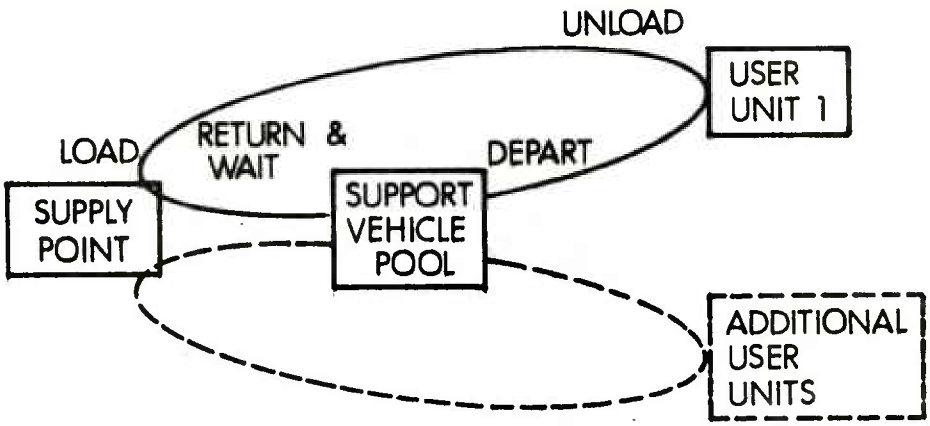


Figure 1. Illustration of a Pickup Mission with Example Entries in Links Array.



LINK NO.	DELAY	LOAD TIME OR ZERO	TRAVEL TIME	DELAY	UNLOAD OR LOAD TIME	TRAVEL TIME	DELAY	LOAD, UNLOAD, OR ZERO
1	2	3	4	5	6	7	8	9
2.	15.	25.	35.	0.	40.	30.	0.	0.

Figure 2. Illustration of a Delivery Mission with Example Entries in Links Array.



LINK NO.	DELAY	LOAD TIME OR ZERO	TRAVEL TIME	DELAY	UNLOAD OR LOAD TIME	TRAVEL TIME	DELAY	LOAD, UNLOAD, OR ZERO
1	2	3	4	5	6	7	8	9
3.	0.	0.	35.	0.	40.	60.	55.	0.

Figure 3. Illustration of a Support Mission with Example Entries in Links Array.

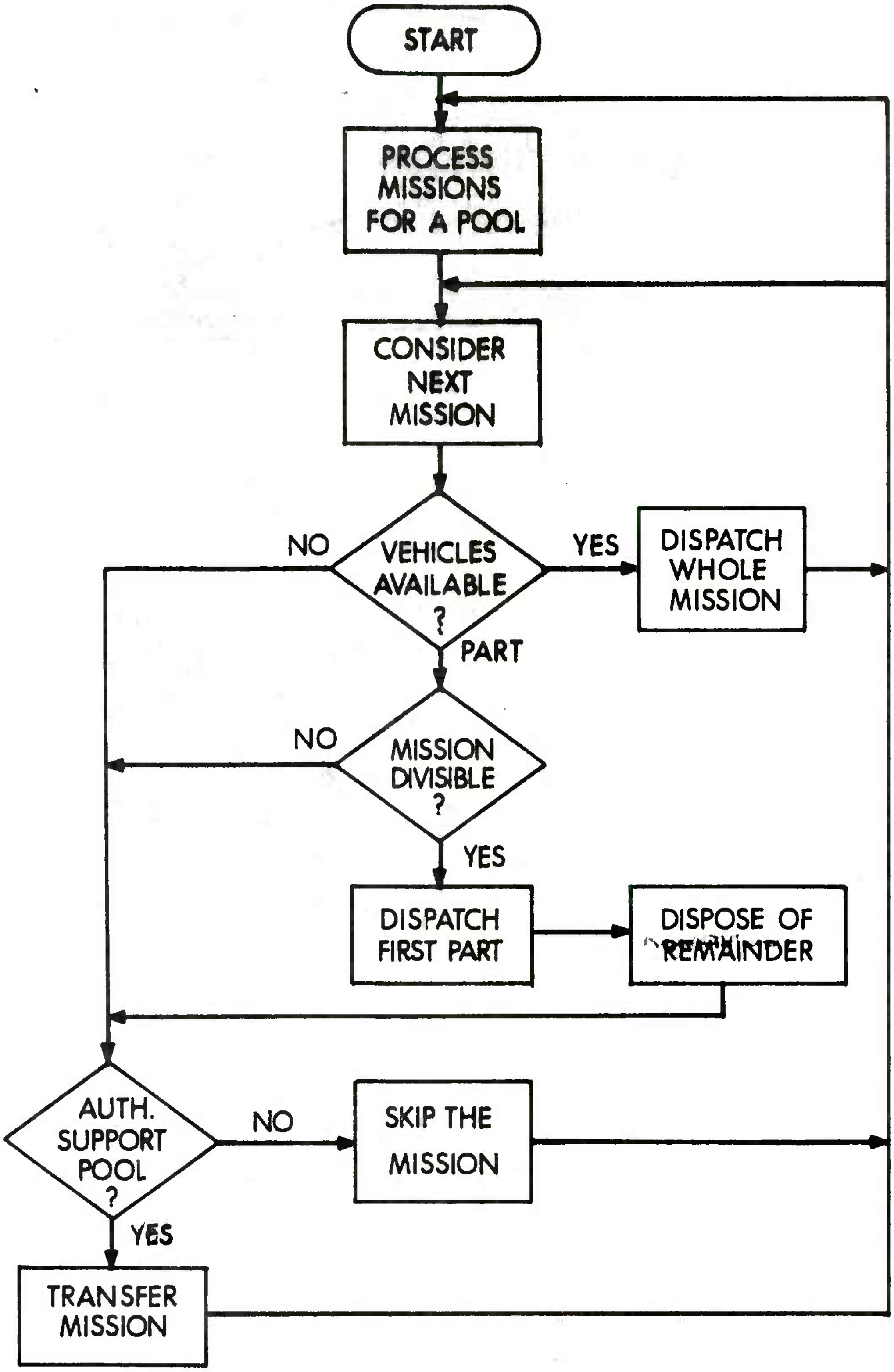


Figure 4. TVEM Flowchart.

and cube. The pool is then checked to see how many vehicles are available relative to the number required. If sufficient vehicles are available, the mission is considered completed and a disposition code for the mission is changed to indicate so. If no vehicles are available, the model checks to see if a support pool is authorized to take the mission. The mission is then either designated for transfer or skipped accordingly. If there are only enough vehicles available to accomplish part of the mission, the model checks to see if the mission can be split. If so, the first part of the mission is considered completed, and the second part is either transferred or skipped as if no vehicles are available. If the mission may not be split, it is handled as if no vehicles are available. During the processing of mission events, the model accumulates various statistics for the vehicles and missions.

For a more detailed discussion of the simulation logic, see Appendix B.

2.5 Model Limitations.

Some inherent limitations of the basic TVEM are the following.

(1) All the vehicles in a given pool must be of the same type in terms of cargo capacity, travel speeds, and load and unload times. It is not clear that the model can be made to simulate a mixed pool consisting of 5-ton and 10-ton trucks, for example, simply through manipulation of input.

> Note. If one wished, however, to simulate a pool consisting of fuel tankers, ammunition trucks, and general cargo trucks, the situation could be handled by setting up three colocated but distinct vehicle pools. A pool consisting of the tankers would be assigned the fuel resupply missions, the ammunition trucks would be assigned the ammunition resupply missions, and the third pool consisting of the general cargo trucks would be assigned the remaining missions.

(2) Mission cargo is characterized to no greater degree than tons and cube in the model.

(3) Scheduled maintenance is not represented in the model, except that one could administer a delay time at the end of each mission to represent the effect on vehicle availability of a per-mission average delay due to scheduled maintenance.

(4) The model does not simulate unscheduled maintenance or the direct effects of enemy combat action on the vehicles.

(5) The information input by means of the links array is in terms of time, not distance. If distances traveled are of interest,

the links array would need to be expanded columnwise to permit the inputting of distances. The logic would then need to be incorporated in the model to tally distances traveled.

(6) The model does not simulate negotiation of mission transfers. Once an additional mission is assigned to a pool as a result of a mission transfer, it cannot be returned to the pool from which it was transferred. Depending upon doctrine, this might not be considered a limitation.

(7) The model is capable of transferring a mission to a second pool if the pool to which it was first transferred cannot complete the mission. However, the model currently has an override mechanism to prevent this (one statement which is easily removable).

(8) The missions assigned to a pool have no associated priorities. Moreover, originally assigned missions have no priority over additionally assigned (transferred) missions or vice-versa.

(9) Missions cannot be deferred in anticipation of slack periods. Indeed the model is very time specific. That is, if an insufficient number of vehicles is available for a mission, it will either be completed in part or transferred or skipped in full with complete disregard of when enough vehicles would be available. Thus, the model would not defer a mission even for one minute.

3. CONCLUSIONS AND RECOMMENDATIONS

While the TVEM can be a useful tool for comparing the performance of various vehicle fleet mixes, its usefulness would be enhanced by several improvements.

(1) The logic should be incorporated in the model to permit deferral of missions.

(2) Travel distances should be incorporated in the information for the routes in addition to the travel times already used. Travel distances are generated during the process of input data development, so a separate exercise would not be necessary. Then the logic should be incorporated in the model to accumulate the distance traveled for each individual vehicle. Once this has been accomplished the model should be expanded to provide an explicit representation of the effects of scheduled and unscheduled maintenance and reliability.

(3) Currently, the model accumulates and outputs statistics by individual pool. The accumulation of fleet-wide statistics would also be quite informative. The fleet-wide report need not be quite as detailed as that given for each pool, rather it would represent a concise summary of fleet performance.

It is envisioned that these model improvements will be undertaken in the near future and that any such modifications will be thoroughly documented.

REFERENCES

1. Addendum To The Special Analysis Of Standard Tactical Wheeled Vehicle Requirements: TACV Addendum, Volume II: Main Report And Appendixes (sic) A Through J, United States Army Training And Doctrine Command, August 1979.

2. Hudak, Paul E., Koenig, Lawrence D., and Swanson, George O., Documentation of the Tactical Vehicle Fleet Simulation Model, General Research Corporation, McLean, Virginia, May 1977.

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APPENDIX A

PROGRAM LISTING

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```
      PROGRAM TVEM(INPUT,OUTPUT,TAPE5=INPUT,TAPE6=OUTPUT,TAPE13)
      DIMENSION  T(100,9,10), A(500,8,10), E(1000,2,10), P(15,10)
      DIMENSION  D(500,8), F(500,2,10), O(4,8,10), Q(12,10), G(18,5)
      INTEGER P
      LEVEL 2, T,A,F,E,D
      COMMON / AAA / T,A,F,E,D
      COMMON / GGG / G
      COMMON / PPP / P
      COMMON / QQQ / Q
      COMMON / MCOL/ MCT,MCA,MCG
      COMMON / MAX / MMISS,MLINK
      DATA MAXP/ 10 /
      DATA MLINK,MCT/ 100, 9 /
      DATA MMISS,MCA/ 500, 8 /
      DATA MRG,MCG/ 18, 5 /
      DATA LIST/ 1 /
      DATA IPLOT/ 0 /
      DATA ISP/ 0 /
   10 FORMAT(16I5)
   20 FORMAT(10F8.0)
  100 FORMAT(1H1)
  110 FORMAT(1H ,125(1HX))
C
C
C
C
C-----------------------------------------------------------------------
C               READ IN THE NUMBER OF POOLS TO BE SIMULATED.
C-----------------------------------------------------------------------
 1000 READ(5,10) NPOOLS
      IF(NPOOLS.LT.0) STOP
      IF(NPOOLS.GT.0 .OR. NPOOLS.LE. MAXP) GO TO 1005
      WRITE(6,160) NPOOLS
  160 FORMAT(1H ,'WARNING--  NUMBER OF POOLS IS',I5)
      STOP
C-----------------------------------------------------------------------
C               READ THE DATA FOR THE POOLS.
C-----------------------------------------------------------------------
 1005 DO 1040 K=1,NPOOLS
C-----------------------------------------------------------------------
C               READ IN --
C               POOL NUMBER, VEHICLE TYPE NUMBER, PAYLOAD (STX10),
C               CAPACITY (CUBE), NUMBER OF TRUCKS IN POOL.
C-----------------------------------------------------------------------
      READ(5,10) (P(J,K),J=1,5)
C-----------------------------------------------------------------------
C               READ IN INFORMATION ON THE LINKS.
C-----------------------------------------------------------------------
      K1=0
      DO 1010 I=1,MLINK
      READ(5,20) (T(I,J,K),J=1,MCT)
      IF(T(I,1,K).LT.0.) GO TO 1020
      K1=I
 1010 CONTINUE
 1020 P(6,K)=K1
C-----------------------------------------------------------------------
C               READ IN INFORMATION ON THE MISSIONS.
```

```
C-----------------------------------------------------------------------
      K1=0
      DO 1030 I=1,MMISS
      READ(5,20) (A(I,J,K),J=1,MCA)
      IF(A(I,1,K).LT.0.) GO TO 1035
      K1=I
 1030 CONTINUE
 1035 P(7,K)=K1
C
      IF(LIST.GT.0) CALL OUT1(K)
C
 1040 CONTINUE
C
C
C
C-----------------------------------------------------------------------
C                 BEGIN SIMULATING THE MISSIONS, PROCESSING ONE POOL AT A
C                        TIME.
C-----------------------------------------------------------------------
      DO 7000 K=1,NPOOLS
      WRITE(6,120) P(1,K)
  120 FORMAT(1H0,10X,'SIMULATING POOL NO.',I5)
      NM=P(7,K)
      IF(NM.LE.0) GO TO 7000
      DO 1060 I=1,4
      DO 1050 J=1,8
      O(I,J,K)=0.
 1050 CONTINUE
 1060 CONTINUE
      NL=P(6,K)
C-----------------------------------------------------------------------
C                 PROCESS THE MISSIONS FOR THIS POOL.
C-----------------------------------------------------------------------
      DO 2010 I=1,NM
      DO 1065 L=1,NL
      I3=L
      IF(T(L,1,K).EQ.A(I,1,K)) GO TO 1070
 1065 CONTINUE
      WRITE(6,130) P(1,K),A(I,1,K)
  130 FORMAT(1H0,'WARNING--- FILE',I3,' DOES NOT CONTAIN LINK',F7.0,10X,
     *'SKIPPING TO NEXT POOL')
      GO TO 7000
 1070 CONTINUE
C-----------------------------------------------------------------------
C                 CALCULATE THE TIME REQUIRED TO ACCOMPLISH THE MISSION,
C                        (IF UNDERTAKEN).
C-----------------------------------------------------------------------
      F(I,1,K)=0.
      DO 1080 J=2,MCT
      F(I,1,K)=F(I,1,K)+T(I3,J,K)
 1080 CONTINUE
      IF(A(I,3,K).EQ.0.) GO TO 1090
C-----------------------------------------------------------------------
C                 CALCULATE DEPARTURE TIME (IN TOTAL MINUTES).
C-----------------------------------------------------------------------
      E(I,1,K)=1440.*A(I,2,K)+A(I,3,K)-40.*AINT(A(I,3,K)/100.)
      GO TO 2000
```

```
C------------------------------------------------------------------------
C              CALCULATE THE DEPARTURE TIME (IN TOTAL MINUTES) REQUIRED
C                   TO MEET THE SCHEDULED DELIVERY TIME.
C------------------------------------------------------------------------
 1990 E(I,1,K)=1440.*A(I,2,K)+A(I,4,K)-40.*AINT(A(I,4,K)/100.)-F(I,1,K)
C------------------------------------------------------------------------
C              IF IT IS A SUPPLY MISSION, DROP THE TIME REQUIRED TO
C                   RETURN TO THE SUPPORT POOL.
C------------------------------------------------------------------------
      IF(T(I3,9,K).EQ.0. .OR. A(I,8,K).GT.2.)
     *                          E(I,1,K)=E(I,1,K)+T(I3,7,K)+T(I3,8,K)
 2000 CONTINUE
C------------------------------------------------------------------------
C              CALCULATE THE TIME THE VEHICLES WILL BE AVAILABLE TO
C                   UNDERTAKE THE NEXT MISSION.
C------------------------------------------------------------------------
      I7=I+P(7,K)
      E(I7,1,K)=E(I,1,K)+F(I,1,K)
      E(I,2,K)=FLOAT(I)
      E(I7,2,K)=-E(I,2,K)
C------------------------------------------------------------------------
C              FIND THE PERCENT WT. CAPACITY OF A VEHICLE REQUIRED FOR
C                   THE MISSION.
C------------------------------------------------------------------------
      B5=100.*A(I,5,K)/FLOAT(P(3,K))
C------------------------------------------------------------------------
C              FIND THE PERCENT CUBE CAPACITY OF A VEHICLE REQUIRED.
C------------------------------------------------------------------------
      B6=100.*A(I,6,K)/FLOAT(P(4,K))
C------------------------------------------------------------------------
C              STORE THE MORE STRINGENT REQUIREMENT.  (THIS IS REALLY
C                   THE NUMBER OF VEHICLES REQUIRED, MULTIPLIED BY 100).
C------------------------------------------------------------------------
      F(I,2,K)=AMAX1(B5,B6)
 2010 CONTINUE
      F(MMISS,1,K)=1.
C------------------------------------------------------------------------
C              SORT THE MISSION TIMES (INCLUDING AVAILABILITY TIMES)
C                   FROM EARLIEST TO LATEST, GIVING A CHRONOLOGICAL
C                   SEQUENCE OF MISSION EVENTS.
C------------------------------------------------------------------------
C
      CALL SORT(K)
C
C------------------------------------------------------------------------
C              STORE THE EARLIEST DISPATCH OR DEPARTURE TIME.
C------------------------------------------------------------------------
      P(9,K)=E(1,1,K)
C------------------------------------------------------------------------
C              STORE LATEST VEHICLE AVAILABILITY TIME.
C------------------------------------------------------------------------
      I7=2*P(7,K)
      P(10,K)=E(I7,1,K)
      P(8,K)=0
      P(11,K)=0
      NZ3=0
      NZ7=0
```

```
      DO 2040 I=1,NM
      IF(A(I,8,K).GT.2) GO TO 2040
      IF(ISP) 2020,2040,2030
 2020 A(I,8,K)=1.
      GO TO 2040
 2030 A(I,8,K)=2.
 2040 CONTINUE
C
C
C
C*************************************************************************
C
C                 PROCESS EACH EVENT.
C
C*************************************************************************
      NZ=NM
      DO 5000 I=1,I7
      NY=INT(ABS(E(I,2,K)))
C-------------------------------------------------------------------------
C                 IS IT A MISSION OR A RETURN FROM A MISSION.
C-------------------------------------------------------------------------
      IF(E(I,2,K).LT.0.) GO TO 2050
C-------------------------------------------------------------------------
C                 DETERMINE THE NUMBER OF VEHICLES REQUIRED FOR THE MISSION
C-------------------------------------------------------------------------
      P(8,K)=P(8,K)+INT(F(NY,2,K)/100.)
      IF(AMOD(F(NY,2,K),100.).GT.0.) P(8,K)=P(8,K)+1
C-------------------------------------------------------------------------
C                 ARE THERE ENOUGH VEHICLES IN THE POOL.
C-------------------------------------------------------------------------
      IF(P(8,K).LE.P(5,K)) GO TO 4050
      NZ7=1
C-------------------------------------------------------------------------
C                 DETERMINE THE NUMBER OF VEHICLES RETURNING FROM A MISSION
C                      OR IF THERE ARE NOT ENOUGH VEHICLES IN THE POOL TO
C                      TAKE THE WHOLE MISSION, RESET THE INDICATOR.
C-------------------------------------------------------------------------
 2050 P(8,K)=P(8,K)-INT(F(NY,2,K)/100.)
      IF(AMOD(F(NY,2,K),100.).GT.0.) P(8,K)=P(8,K)-1
      IF(NZ7.EQ.0) GO TO 5000
      NZ7=0
      I8=INT(A(NY,8,K))
      IF(I8.GT.8) I8=I8-13
      GO TO (2060,3020,5000,3040,5000,3050,5000,4020), I8
C
C
 2060 IF(P(8,K).EQ.P(5,K)) GO TO 3000
      A(NY,8,K)=25.
      NZ=NZ+1
      BT=AMAX1(A(NY,5,K)/FLOAT(P(3,K)),A(NY,6,K)/FLOAT(P(4,K)))
      ZT=FLOAT(P(5,K)-P(8,K))
      Z5=100.*ZT
      TEMP=ZT/BT
C-------------------------------------------------------------------------
C                 HOW MUCH OF THIS CARGO CAN THE POOL HAUL (IN TONS AND
C                      CUBE) WITH THE VEHICLES AVAILABLE.
C-------------------------------------------------------------------------
```

```
      B5=A(NY,5,K)*TEMP
      B6=A(NY,6,K)*TEMP
      F(NY,2,K)=Z5
C-----------------------------------------------------------------------
C                 INCREASE THE INDICATOR TO ACCOUNT FOR THE PARTIAL MISSION
C-----------------------------------------------------------------------
      P(8,K)=P(5,K)
C-----------------------------------------------------------------------
C                 STORE THE INFO ON THE MISSION COMPLETED IN PART.  THE
C                       REMAINDER OF THE SPLIT MISSION WILL BE SKIPPED OR
C                       TRANSFERRED (SEE BELOW).
C-----------------------------------------------------------------------
      DO 2070 J=1,MCA
      A(NZ,J,K)=A(NY,J,K)
 2070 CONTINUE
      A(NZ,5,K)=B5
      A(NZ,6,K)=B6
      A(NZ,8,K)=3.
      F(NZ,1,K)=F(NY,1,K)
      F(NZ,2,K)=Z5
      NA=2*NZ
      E(NA,1,K)=E(I,1,K)+F(NY,1,K)
      E(NA,2,K)=-FLOAT(NZ)
      NB=NA-1
      E(NB,1,K)=E(I,1,K)
      E(NB,2,K)= FLOAT(NZ)
      F(MMISS,1,K)=3.
C-----------------------------------------------------------------------
C                 FIND THE AMOUNT OF CARGO REMAINING FROM THE SPLIT MISSION
C-----------------------------------------------------------------------
      B5=A(NY,5,K)-B5
      B6=A(NY,6,K)-B6
C-----------------------------------------------------------------------
C                 STORE, FOR REPORTING LATER, THE INFO ON PARTIAL MISSIONS
C                       SKIPPED OR TRANSFERRED.
C                             L1=1 -- ORIGINAL MISSION TRANSFERRED,
C                             L1=2 -- ORIGINAL MISSION SKIPPED.
C                       IN EACH CASE THIS IS THE REMAINDER OF A SPLIT
C                       MISSION.
C-----------------------------------------------------------------------
      L1=1
      IF(A(NY,7,K).EQ.0.) L1=2
      O(L1,1,K)=O(L1,1,K)+1.
      O(L1,2,K)=O(L1,2,K)+B5
      O(L1,4,K)=O(L1,4,K)+B6
C-----------------------------------------------------------------------
C                 CAN THE REMAINDER OF THE MISSION BE TRANSFERRED.
C-----------------------------------------------------------------------
      IF(A(NY,7,K).EQ.0.) GO TO 4080
C-----------------------------------------------------------------------
C                 INCREASE THE COUNTER FOR MISSIONS TRANSFERRED AND STORE
C                       THE MISSION INFO.
C-----------------------------------------------------------------------
      P(11,K)=P(11,K)+1
      IP=P(11,K)
      DO 2080 J=1,MCA
      D(IP,J)=A(NY,J,K)
```

```
 2080 CONTINUE
      D(IP,5)=B5
      D(IP,6)=B6
      D(IP,8)=4.
      GO TO 4080
C
C
C-----------------------------------------------------------------------
C              NO VEHICLES AVAILABLE TO HAUL EVEN PART OF THE CARGO.  IF
C                   THE MISSION CAN'T BE TRANSFERRED, IT WILL BE SKIPPED
C-----------------------------------------------------------------------
 3000 F(NY,2,K)=0.
      A(NY,8,K)=7.
C-----------------------------------------------------------------------
C              CAN THE MISSION BE TRANSFERRED.
C-----------------------------------------------------------------------
      IF(A(NY,7,K).EQ.0.) GO TO 4080
C-----------------------------------------------------------------------
C              STORE THE INFO FOR THE MISSION TO BE TRANSFERRED.
C-----------------------------------------------------------------------
      A(NY,8,K)=6.
      P(11,K)=P(11,K)+1
      IP=P(11,K)
      DO 3010 J=1,MCA
      D(IP,J)=A(NY,J,K)
 3010 CONTINUE
      GO TO 4080
C
C
C-----------------------------------------------------------------------
C              THE MISSION CAN'T BE SPLIT.  IF IT CAN'T BE TRANSFERRED,
C                   IT WILL BE SKIPPED.
C-----------------------------------------------------------------------
 3020 F(NY,2,K)=0.
      A(NY,8,K)=9.
C-----------------------------------------------------------------------
C              CAN THE MISSION BE TRANSFERRED.
C-----------------------------------------------------------------------
      IF(A(NY,7,K).EQ.0.) GO TO 4080
C-----------------------------------------------------------------------
C              STORE THE INFO FOR THE MISSION TO BE TRANSFERRED.
C-----------------------------------------------------------------------
      A(NY,8,K)=8.
      P(11,K)=P(11,K)+1
      IP=P(11,K)
      DO 3030 J=1,MCA
      D(IP,J)=A(NY,J,K)
 3030 CONTINUE
      GO TO 4080
C
C
C-----------------------------------------------------------------------
C              ADDITIONAL MISSION RESULTING FROM TRANSFERRAL OF THE
C                   REMAINDER OF A SPLIT MISSION.  SINCE THERE ARE NOT
C                   ENOUGH VEHICLES, THE MISSION WILL BE SKIPPED (WILL
C                   NOT BE SPLIT FURTHER).
C-----------------------------------------------------------------------
```

```
 3040 F(NY,2,K)=0.
      A(NY,8,K)=11.
      GO TO 4080
C
C
C------------------------------------------------------------------------
C               ADDITIONAL MISSION RESULTING FROM TRANSFERRAL OF AN
C                     ENTIRE MISSION.
C------------------------------------------------------------------------
 3050 IF(P(8,K).EQ.P(5,K)) GO TO 4000
      A(NY,8,K)=24.
      NZ=NZ+1
      BT=AMAX1(A(NY,5,K)/FLOAT(P(3,K)),A(NY,6,K)/FLOAT(P(4,K)))
      ZT=FLOAT(P(5,K)-P(8,K))
      Z5=100.*ZT
      TEMP=ZT/BT
C------------------------------------------------------------------------
C               HOW MUCH OF THIS CARGO CAN THE POOL HAUL (IN TONS AND
C                     CUBE) WITH THE VEHICLES AVAILABLE.
C------------------------------------------------------------------------
      B5=A(NY,5,K)*TEMP
      B6=A(NY,6,K)*TEMP
      F(NY,2,K)=Z5
C------------------------------------------------------------------------
C               INCREASE THE INDICATOR TO ACCOUNT FOR THE PARTIAL MISSION
C------------------------------------------------------------------------
      P(8,K)=P(5,K)
C------------------------------------------------------------------------
C               STORE THE INFO ON THE MISSION COMPLETED IN PART.  THE
C                     REMAINDER OF THE SPLIT MISSION WILL BE SKIPPED
C                     BECAUSE, AS THE MODEL NOW STANDS, IT WILL NOT BE
C                     TRANSFERRED TO YET ANOTHER POOL.
C------------------------------------------------------------------------
      DO 3060 J=1,MCA
      A(NZ,J,K)=A(NY,J,K)
 3060 CONTINUE
      A(NZ,5,K)=B5
      A(NZ,6,K)=B6
      A(NZ,8,K)=16.
      F(NZ,1,K)=F(NY,1,K)
      F(NZ,2,K)=Z5
      NA=2*NZ
      E(NA,1,K)=E(I,1,K)+F(NY,1,K)
      E(NA,2,K)=-FLOAT(NZ)
      NB=NA-1
      E(NB,1,K)=E(I,1,K)
      E(NB,2,K)= FLOAT(NZ)
      F(MMISS,1,K)=3.
C------------------------------------------------------------------------
C               FIND THE AMOUNT OF CARGO REMAINING FROM A SPLIT MISSION.
C------------------------------------------------------------------------
      B5=A(NY,5,K)-B5
      B6=A(NY,6,K)-B6
C------------------------------------------------------------------------
C               STORE, FOR REPORTING LATER, THE INFO ON PARTIAL MISSIONS
C                     SKIPPED OR TRANSFERRED.
C                           L1=3 -- ADDITIONAL MISSION TRANSFERRED,
```

```
C                        L1=4 -- ADDITIONAL MISSION SKIPPED.               MAIN
C------------------------------------------------------------------------- MAIN
      L1=3                                                                 MAIN
      IF(A(NY,7,K).EQ.0.) L1=4                                             MAIN
      O(L1,1,K)=O(L1,1,K)+1.                                               MAIN
      O(L1,2,K)=O(L1,2,K)+B5                                               MAIN
      O(L1,4,K)=O(L1,4,K)+B6                                               MAIN
C------------------------------------------------------------------------- MAIN
C              CAN THE MISSION BE TRANSFERRED.                             MAIN
C------------------------------------------------------------------------- MAIN
      IF(A(NY,7,K).EQ.0.) GO TO 4080                                       MAIN
C------------------------------------------------------------------------- MAIN
C              STORE THE INFO FOR THE MISSION TO BE TRANSFERRED.           MAIN
C------------------------------------------------------------------------- MAIN
      P(11,K)=P(11,K)+1                                                    MAIN
      IP=P(11,K)                                                           MAIN
      DO 3070 J=1,MCA                                                      MAIN
      D(IP,J)=A(NY,J,K)                                                    MAIN
 3070 CONTINUE                                                             MAIN
      D(IP,5)=B5                                                           MAIN
      D(IP,6)=B6                                                           MAIN
      D(IP,8)=17.                                                          MAIN
      GO TO 4080                                                           MAIN
C                                                                          MAIN
C                                                                          MAIN
C------------------------------------------------------------------------- MAIN
C              NO VEHICLES AVAILABLE TO HAUL EVEN PART OF THE CARGO.  IF   MAIN
C                   THE MISSION CAN'T BE TRANSFERRED, IT WILL BE SKIPPED   MAIN
C------------------------------------------------------------------------- MAIN
 4000 F(NY,2,K)=0.                                                         MAIN
      A(NY,8,K)=13.                                                        MAIN
C------------------------------------------------------------------------- MAIN
C              CAN THE MISSION BE TRANSFERRED.                             MAIN
C------------------------------------------------------------------------- MAIN
      IF(A(NY,7,K).EQ.0.) GO TO 4080                                       MAIN
C------------------------------------------------------------------------- MAIN
C              STORE THE INFO FOR THE MISSION TO BE TRANSFERRED.           MAIN
C------------------------------------------------------------------------- MAIN
      A(NY,8,K)=19.                                                        MAIN
      P(11,K)=P(11,K)+1                                                    MAIN
      IP=P(11,K)                                                           MAIN
      DO 4010 J=1,MCA                                                      MAIN
      D(IP,J)=A(NY,J,K)                                                    MAIN
 4010 CONTINUE                                                             MAIN
      GO TO 4080                                                           MAIN
C                                                                          MAIN
C                                                                          MAIN
C------------------------------------------------------------------------- MAIN
C              THE MISSION CAN'T BE SPLIT.  IF IT CAN'T BE TRANSFERRED,    MAIN
C                   IT WILL BE SKIPPED.                                    MAIN
C------------------------------------------------------------------------- MAIN
 4020 F(NY,2,K)=0.                                                         MAIN
      A(NY,8,K)=15.                                                        MAIN
C------------------------------------------------------------------------- MAIN
C              CAN THE MISSION BE TRANSFERRED.                             MAIN
C------------------------------------------------------------------------- MAIN
      IF(A(NY,7,K).EQ.0.) GO TO 4080                                       MAIN
```

```
C-----------------------------------------------------------------------
C                 STORE THE INFO FOR THE MISSION TO BE TRANSFERRED.
C-----------------------------------------------------------------------
      A(NY,8,K)=21.
      P(11,K)=P(11,K)+1
      IP=P(11,K)
      DO 4030 J=1,MCA
      D(IP,J)=A(NY,J,K)
 4030 CONTINUE
      GO TO 4080
C
C
C-----------------------------------------------------------------------
C                 SET THE MISSION DISPOSITION INDICATOR FOR MISSIONS THAT
C                       WERE COMPLETED.
C-----------------------------------------------------------------------
 4050 I8=INT(A(NY,8,K))
      A(NY,8,K)=10.
      IF(I8.EQ.4 .OR. I8.EQ.17) GO TO 4080
      A(NY,8,K)=12.
      IF(I8.EQ.6 .OR. I8.EQ.19) GO TO 4080
      A(NY,8,K)=14.
      IF(I8.EQ.8 .OR. I8.EQ.21) GO TO 4080
      A(NY,8,K)=FLOAT(I8)
C-----------------------------------------------------------------------
C                 SET THE INDICATOR FOR MAXIMUM VEHICLE USEAGE IN THE POOL.
C-----------------------------------------------------------------------
 4080 IF(P(8,K).LE.NZ3) GO TO 5000
      NZ3=P(8,K)
 5000 CONTINUE
C
C
C
      P(7,K)=NZ
      P(8,K)=NZ3
      DO 5010 I=1,NZ
      IF(A(I,8,K).LT.24.) GO TO 5010
      F(I,2,K)=0.
 5010 CONTINUE
C
      CALL SORT(K)
C
C-----------------------------------------------------------------------
C                 MOVE THE INFORMATION ON MISSIONS TO BE TRANSFERRED TO THE
C                       PROPER POOLS.
C-----------------------------------------------------------------------
      IF(P(11,K).EQ.0) GO TO 6000
      NTRANS=P(11,K)
      DO 5050 KK=1,NPOOLS
      IF(KK.EQ.K) GO TO 5050
      FK=FLOAT(KK)
      DO 5040 NN=1,NTRANS
      T7=D(NN,7)-100.*FLOAT(INT(D(NN,7)/100.))
      IF(T7.NE.FK) GO TO 5040
      IF(P(7,KK).LT.MMISS) GO TO 5020
      WRITE(6,100)
      WRITE(6,110)
```

```
      WRITE(6,140) KK,P(7,KK)
  140 FORMAT(1H ,'WARNING--- MISSION OVERFLOW IN POOL',I3,10X,'TRUNCATED
     * AT ',I4,' MISSIONS')
      WRITE(6,110)
      GO TO 5050
 5020 P(7,KK)=P(7,KK)+1
      I7=P(7,KK)
      DO 5030 J=1,MCA
      A(I7,J,KK)=D(NN,J)
 5030 CONTINUE
      A(I7,7,KK)=FLOAT(INT(D(NN,7)/100.))
C-----------------------------------------------------------------------
C                 MISSION WILL NOT BE TRANSFERRED TO YET ANOTHER POOL.
C                    (THIS OVERRIDES THE PREVIOUS STATEMENT).
C-----------------------------------------------------------------------
      A(I7,7,KK)=0.
 5040 CONTINUE
 5050 CONTINUE
 6000 CONTINUE
C
C
C-----------------------------------------------------------------------
C                 CALCULATE VEHICLE STATISTICS.
C-----------------------------------------------------------------------
      F1=0.
      F2=0.
      F3=0.
      F4=0.
      DO 6005 I=1,12
      Q(I,K)=0.
 6005 CONTINUE
      I7=P(7,K)
      DO 6040 I=1,I7
      IF(F(I,2,K).EQ.0.) GO TO 6040
      DO 6010 L=1,NL
      NY=L
      IF(T(L,1,K).EQ.A(I,1,K)) GO TO 6015
 6010 CONTINUE
 6015 CONTINUE
      F5=F(I,2,K)/100.
      F1=F1+F5
      F2=F2+AINT(F5)
      F3=F3+A(I,6,K)
      F4=F4+A(I,5,K)
      IF(AMOD(F(I,2,K),100.).EQ.0.) GO TO 6020
      F2=F2+1.
      F(I,2,K)=100.*AINT(F5)+100.
      F5=F(I,2,K)/100.
 6020 Q(1,K)=Q(1,K)+F5*(T(NY,4,K)+T(NY,7,K))
      Q(2,K)=Q(2,K)+F5*T(NY,2,K)
      Q(3,K)=Q(3,K)+F5*T(NY,5,K)
      Q(4,K)=Q(4,K)+F5*T(NY,8,K)
      IF(T(NY,9,K).EQ.0.) GO TO 6030
C-----------------------------------------------------------------------
C                 FOR PICK-UP MISSIONS.
C-----------------------------------------------------------------------
      Q(5,K)=Q(5,K)+F5*T(NY,6,K)
```

```
      Q(6,K)=Q(6,K)+F5*T(NY,9,K)
      GO TO 6040
C-----------------------------------------------------------------------
C                FOR DELIVERY OR SUPPORT MISSIONS.
C-----------------------------------------------------------------------
 6030 Q(5,K)=Q(5,K)+F5*T(NY,3,K)
      Q(6,K)=Q(6,K)+F5*T(NY,6,K)
 6040 CONTINUE
      IF(P(5,K).EQ.0) GO TO 6050
C-----------------------------------------------------------------------
C                UNUSED CAPACITY-
C-----------------------------------------------------------------------
      Q(7,K)=100.*(F2-F1)/F2
C-----------------------------------------------------------------------
C                CUBIC EFFICIENCY-
C-----------------------------------------------------------------------
      Q(8,K)=100.*F3/(F1*FLOAT(P(4,K)))
C-----------------------------------------------------------------------
C                WEIGHT EFFICIENCY-
C-----------------------------------------------------------------------
      Q(9,K)=100.*F4/(F1*FLOAT(P(3,K)))
 6050 CONTINUE
 7000 CONTINUE
C
C
C
C
C***********************************************************************
C
C          POST-PROCESSOR SECTION
C
C***********************************************************************
      DO 10000 K=1,NPOOLS
      WRITE(6,100)
      WRITE(6,110)
C
      CALL OUT2(K)
C
      DO 7060 I=1,MRG
      DO 7050 J=1,MCG
      G(I,J)=0.
 7050 CONTINUE
 7060 CONTINUE
      NM=P(7,K)
      IF(NM.LE.0) GO TO 9050
      DO 9010 I=1,NM
      L=INT(A(I,8,K))
      IF(L.GE.1 .AND. L.LE.25) GO TO (7070,7070,8000,9010,9010,7080,7090
     A ,7080,7090,8010,8020,8030,8040,8030,8040,8060,8050,9010,8035,9010
     B ,8035,9010,9010,8050,8070), L
      WRITE(6,150) L
  150 FORMAT(1H ,'WARNING-- IMPROPER MISSION DISPOSITION CODE-',I5)
      GO TO 9010
C-----------------------------------------------------------------------
C                MISSION COMPLETED IN FULL.  A8 CODE WAS 1 OR 2.
C-----------------------------------------------------------------------
 7070 I1=2
```

```
      I2=1
      GO TO 8090
C-----------------------------------------------------------------------
C              MISSION TRANSFERRED IN FULL.  A8 CODE WAS 6 OR 8.
C-----------------------------------------------------------------------
 7080 I1=3
      I2=1
      GO TO 8090
C-----------------------------------------------------------------------
C              MISSION SKIPPED IN FULL.  A8 CODE WAS 7 OR 9.
C-----------------------------------------------------------------------
 7090 I1=4
      I2=1
      GO TO 8090
C-----------------------------------------------------------------------
C              MISSION COMPLETED IN PART.  A8 CODE WAS 3.
C-----------------------------------------------------------------------
 8000 I1=5
      GO TO 9000
C-----------------------------------------------------------------------
C              ADDITIONAL FRACTIONAL MISSION COMPLETED.  A8 CODE WAS 10.
C-----------------------------------------------------------------------
 8010 I1=10
      I2=9
      I3=8
      GO TO 8080
C-----------------------------------------------------------------------
C              ADDITIONAL FRACTIONAL MISSION SKIPPED.  A8 CODE WAS 11.
C-----------------------------------------------------------------------
 8020 I1=11
      I2=9
      I3=8
      GO TO 8080
C-----------------------------------------------------------------------
C              ADDITIONAL MISSION COMPLETED IN FULL.  A8 CODE- 12 OR 14.
C-----------------------------------------------------------------------
 8030 I1=13
      I2=12
      I3=8
      GO TO 8080
C-----------------------------------------------------------------------
C               ADDITIONAL MISSION TRANSFERRED IN FULL. A8 CODE-19 OR 21
C-----------------------------------------------------------------------
 8035 I1=14
      I2=12
      I3=8
      GO TO 8080
C-----------------------------------------------------------------------
C              ADDITIONAL MISSION SKIPPED IN FULL.  A8 CODE WAS 13 OR 15
C-----------------------------------------------------------------------
 8040 I1=15
      I2=12
      I3=8
      GO TO 8080
C-----------------------------------------------------------------------
C              ADDITIONAL MISSION TRANSFERRED OR SKIPPED IN PART.
C                   A8 CODE WAS 17 OR 24.
```

```
C-----------------------------------------------------------------------
 8050 I1=12
      I2=8
      GO TO 8090
C-----------------------------------------------------------------------
C                  ADDITIONAL MISSION COMPLETED IN PART.  A8 CODE WAS 16.
C-----------------------------------------------------------------------
 8060 I1=16
      GO TO 9000
C-----------------------------------------------------------------------
C                  MISSION SKIPPED IN PART.  A8 CODE WAS 25.
C-----------------------------------------------------------------------
 8070 I1=1
      GO TO 9000
 8080 G(I3,1)=G(I3,1)+1.
      G(I3,2)=G(I3,2)+A(I,5,K)
      G(I3,4)=G(I3,4)+A(I,6,K)
 8090 G(I2,1)=G(I2,1)+1.
      G(I2,2)=G(I2,2)+A(I,5,K)
      G(I2,4)=G(I2,4)+A(I,6,K)
 9000 G(I1,1)=G(I1,1)+1.
      G(I1,2)=G(I1,2)+A(I,5,K)
      G(I1,4)=G(I1,4)+A(I,6,K)
 9010 CONTINUE
C-----------------------------------------------------------------------
C                  ORIGINAL MISSIONS EITHER TRANSFERRED IN PART OR SKIPPED
C                        IN PART.
C                  ADDITIONAL WHOLE MISSIONS EITHER TRANSFERRED OR SKIPPED
C                        IN PART.
C-----------------------------------------------------------------------
      DO 9020 J=1,MCG
      G(6,J)=O(1,J,K)
      G(7,J)=O(2,J,K)
      G(17,J)=O(3,J,K)
      G(MRG,J)=O(4,J,K)
 9020 CONTINUE
      DO 9030 I=1,MRG
      G(I,3)=100.*G(I,2)/(G(1,2)+G(8,2))
      G(I,5)=100.*G(I,4)/(G(1,4)+G(8,4))
 9030 CONTINUE
      DO 9040 I=1,MRG
      G(I,2)=G(I,2)/10.
      G(I,4)=G(I,4)/100.
 9040 CONTINUE
C
      CALL OUT3
      CALL OUT4(K)
C
      IF(IPLOT.EQ.0) GO TO 9050
C
      CALL PLOT(K)
C
 9050 WRITE(6,110)
10000 CONTINUE
      GO TO 1000
      END
```

```
C*********************************************************************
C
C**** SUBROUTINE SORT
C        SORT TIMES FOR THE POOL.
C
C*********************************************************************
      SUBROUTINE SORT(K)
      DIMENSION  T(100,9,10), A(500,8,10), E(1000,2,10), P(15,10)
      DIMENSION  D(500,8), F(500,2,10)
      INTEGER P
      LEVEL 2, T,A,F,E,D
      COMMON / AAA / T,A,F,E,D
      COMMON / MAX / MMISS,MLINK
      COMMON / PPP / P
C
C
      KS=INT(F(MMISS,1,K))
      IF(KS.EQ.2) GO TO 500
      IF(KS.GE.3) GO TO 200
      F(MMISS,1,K)=2.
  200 JM=2*P(7,K)
      IM=JM-1
      DO 400 I=1,IM
      I1=I+1
      DO 300 J=I1,JM
      IF(E(I,1,K).LT.E(J,1,K)) GO TO 300
      IF(E(I,1,K).GT.E(J,1,K)) GO TO 210
      IF(E(I,2,K).LE.E(J,2,K)) GO TO 300
      GO TO 250
  210 TEMP=E(I,1,K)
      E(I,1,K)=E(J,1,K)
      E(J,1,K)=TEMP
  250 TEMP=E(I,2,K)
      E(I,2,K)=E(J,2,K)
      E(J,2,K)=TEMP
  300 CONTINUE
  400 CONTINUE
  500 RETURN
      END
```

```
C***********************************************************************
C
C**** SUBROUTINE OUT1
C         PRINT OUT INPUT DATA FOR THE POOL.
C
C***********************************************************************
      SUBROUTINE OUT1(K)
      DIMENSION  T(100,9,10), A(500,8,10), E(1000,2,10), P(15,10)
      DIMENSION  D(500,8), F(500,2,10)
      INTEGER P
      LEVEL 2, T,A,F,E,D
      COMMON / AAA / T,A,F,E,D
      COMMON / MCOL/ MCT,MCA,MCG
      COMMON / PPP / P
    5 FORMAT(1H )
   10 FORMAT(1H1)
   20 FORMAT(1H ,125(1HX))
  100 FORMAT(1H ,125(1H-))
  110 FORMAT(1H0)
C
C
      WRITE(6,10)
      WRITE(6,20)
      WRITE(6,30) P(1,K)
   30 FORMAT(1H0,10X,'POOL NUMBER      ',I5)
      WRITE(6,40) P(2,K)
   40 FORMAT(1H ,10X,'VEHICLE NUMBER  ',I5)
      WRITE(6,50) P(3,K)
   50 FORMAT(1H ,10X,'VEH. PAY.(STX10)',I5)
      WRITE(6,60) P(4,K)
   60 FORMAT(1H ,10X,'VEH. CUBIC CAP. ',I5)
      WRITE(6,70) P(5,K)
   70 FORMAT(1H ,10X,'NO. OF VEHICLES ',I5)
      WRITE(6,80) P(6,K)
   80 FORMAT(1H ,10X,'NUMBER OF LINKS ',I5)
      WRITE(6,90) P(7,K)
   90 FORMAT(1H ,10X,'NO. OF MISSIONS ',I5)
      WRITE(6,100)
      WRITE(6,110)
      WRITE(6,115)
  115 FORMAT(1H0,59X,'LINKS')
      WRITE(6,116)
  116 FORMAT(1H ,59X,'-----')
      WRITE(6,5)
      WRITE(6,120)
  120 FORMAT(1H ,20X,'C1          C2          C3          C4          C5
     *C6          C7          C8          C9')
      WRITE(6,130)
  130 FORMAT(1H ,'T(R,C)',7X,'/','---------------------------------------
     *--------------------------------------------------------')
      N=P(6,K)
      IF(N.GT.0) GO TO 135
      WRITE(6,133)
  133 FORMAT(1H0,51X,'NO LINKS ASSIGNED')
      GO TO 153
  135 DO 150 I=1,N
      WRITE(6,140) I,(T(I,J,K),J=1,MCT)
```

```
  140 FORMAT(1H ,6X,'R',I3,3X,'/',9F10.1)
  150 CONTINUE
  153 WRITE(6,110)
      WRITE(6,110)
      WRITE(6,155)
  155 FORMAT(1H0,52X,'MISSIONS')
      WRITE(6,156)
  156 FORMAT(1H ,52X,'--------')
      WRITE(6,5)
      WRITE(6,157)
  157 FORMAT(1H ,20X,'C1         C2         C3         C4         C5
     *C6         C7         C8')
      WRITE(6,160)
  160 FORMAT(1H ,'A(R,C)',7X,'/','--------------------------------------
     *------------------------------------------')
      N=P(7,K)
      IF(N.GT.0) GO TO 164
      WRITE(6,163)
  163 FORMAT(1H0,47X,'NO MISSIONS ASSIGNED')
      GO TO 175
  164 DO 170 I=1,N
      WRITE(6,165) I,(A(I,J,K),J=1,MCA)
  165 FORMAT(1H ,6X,'R',I3,3X,'/',8F10.1)
  170 CONTINUE
  175 WRITE(6,110)
      WRITE(6,110)
      WRITE(6,20)
      RETURN
      END
```

```
C***********************************************************************
C
C**** SUBROUTINE OUT2
C        PRINT HEADING FOR OUTPUT FROM SIMULATION.
C
C***********************************************************************
      SUBROUTINE OUT2(K)
      DIMENSION  P(15,10)
      INTEGER P
      COMMON / PPP / P
    5 FORMAT(1H )
C
C
      WRITE(6,10) P(1,K)
   10 FORMAT(1H0,10X,'OUTPUT FOR POOL NO.     ',I5)
      WRITE(6,20) P(2,K)
   20 FORMAT(1H ,10X,'VEHICLE NUMBER          ',I5)
      WRITE(6,30) P(3,K)
   30 FORMAT(1H ,10X,'VEHICLE PAYLOAD (STX10)',I5)
      WRITE(6,40) P(4,K)
   40 FORMAT(1H ,10X,'VEHICLE CUBIC CAPACITY ',I5)
      WRITE(6,50) P(5,K)
   50 FORMAT(1H ,10X,'NO. OF VEHICLES IN POOL',I5)
      IF(P(7,K).GT.0) GO TO 100
      WRITE(6,60)
   60 FORMAT(1H0,20X,'NO MISSIONS ASSIGNED')
  100 WRITE(6,5)
      RETURN
      END
```

```
C*************************************************************************
C
C**** SUBROUTINE OUT3
C         PRINT MISSION STATUS REPORT.
C
C*************************************************************************
      SUBROUTINE OUT3
      DIMENSION G(18,5)
      COMMON / GGG / G
      COMMON / MCOL/ MCT,MCA,MCG
   10 FORMAT(1H0)
 1000 FORMAT(1H+,31X,F4.0,F10.1,1X,F8.1,F9.1,1X,F8.1)
C
C
      WRITE(6,10)
      WRITE(6,10)
      WRITE(6,20)
   20 FORMAT(1H ,'M I S S I O N   S T A T U S   R E P O R T')
      WRITE(6,30)
   30 FORMAT(1H ,'-----------------------------------------')
      WRITE(6,40)
   40 FORMAT(1H0,31X,' NO.      S.T.    % ST    100 CF    % CF')
      WRITE(6,50)
   50 FORMAT(1H ,31X,'-----  --------  ------  --------  ------')
      WRITE(6,60)
      WRITE(6,1000) (G(1,J),J=1,MCG)
   60 FORMAT(1H ,'1) ORIGINAL MISSIONS ASSIGNED  ')
      WRITE(6,70)
      WRITE(6,1000) (G(2,J),J=1,MCG)
   70 FORMAT(1H ,9X,'COMPLETED IN FULL      ')
      WRITE(6,80)
      WRITE(6,1000) (G(3,J),J=1,MCG)
   80 FORMAT(1H ,9X,'CONTRACTED IN FULL     ')
      WRITE(6,90)
      WRITE(6,1000) (G(4,J),J=1,MCG)
   90 FORMAT(1H ,9X,'SKIPPED IN FULL        ')
      WRITE(6,100)
      WRITE(6,1000) (G(5,J),J=1,MCG)
  100 FORMAT(1H ,9X,'    COMPLETED IN PART  ')
      WRITE(6,110)
      WRITE(6,1000) (G(6,J),J=1,MCG)
  110 FORMAT(1H ,9X,'    CONTRACTED IN PART ')
      WRITE(6,120)
      WRITE(6,1000) (G(7,J),J=1,MCG)
  120 FORMAT(1H ,9X,'    SKIPPED IN PART    ')
      WRITE(6,130)
      WRITE(6,1000) (G(8,J),J=1,MCG)
  130 FORMAT(1H0,'2) ADDITIONAL MISSIONS ASSIGNED')
      WRITE(6,140)
      WRITE(6,1000) (G(9,J),J=1,MCG)
  140 FORMAT(1H ,9X,'FRACTIONAL MISSIONS    ')
      WRITE(6,150)
      WRITE(6,1000)(G(10,J),J=1,MCG)
  150 FORMAT(1H ,9X,'  COMPLETED            ')
      WRITE(6,160)
      WRITE(6,1000)(G(11,J),J=1,MCG)
  160 FORMAT(1H ,9X,'  SKIPPED              ')
```

```
      WRITE(6,170)
      WRITE(6,1000)(G(12,J),J=1,MCG)
  170 FORMAT(1H ,9X,'WHOLE MISSIONS          ')
      WRITE(6,180)
      WRITE(6,1000)(G(13,J),J=1,MCG)
  180 FORMAT(1H ,9X,'  COMPLETED IN FULL     ')
      WRITE(6,185)
      WRITE(6,1000)(G(14,J),J=1,MCG)
  185 FORMAT(1H ,9X,'  CONTRACTED IN FULL    ')
      WRITE(6,190)
      WRITE(6,1000)(G(15,J),J=1,MCG)
  190 FORMAT(1H ,9X,'  SKIPPED IN FULL       ')
      WRITE(6,200)
      WRITE(6,1000)(G(16,J),J=1,MCG)
  200 FORMAT(1H ,9X,'  COMPLETED IN PART     ')
      WRITE(6,210)
      WRITE(6,1000)(G(17,J),J=1,MCG)
  210 FORMAT(1H ,9X,'  CONTRACTED IN PART    ')
      WRITE(6,220)
      WRITE(6,1000)(G(18,J),J=1,MCG)
  220 FORMAT(1H ,9X,'  SKIPPED IN PART       ')
      RETURN
      END
```

```
C***********************************************************************
C
C**** SUBROUTINE OUT4
C        PRINT VEHICLE STATUS REPORT.
C
C***********************************************************************
      SUBROUTINE OUT4(K)
      DIMENSION  T(100,9,10), A(500,8,10), E(1000,2,10), P(15,10)
      DIMENSION  D(500,8), F(500,2,10), Q(12,10)
      INTEGER P
      LEVEL 2, T,A,F,E,D
      COMMON / AAA / T,A,F,E,D
      COMMON / PPP / P
      COMMON / QQQ / Q
    5 FORMAT(1H )
   10 FORMAT(1H0)
 1000 FORMAT(1H+,23X,F10.1,8X,F6.1,7X,F8.2)
C
C
      WRITE(6,10)
      WRITE(6,10)
      WRITE(6,20)
   20 FORMAT(1H ,'V E H I C L E   S T A T U S   R E P O R T')
      WRITE(6,30)
   30 FORMAT(1H ,'-----------------------------------------')
      WRITE(6,40) P(8,K)
   40 FORMAT(1H ,'NO. OF VEHICLES USED           ',I3)
      IF(P(8,K).GT.0) GO TO  60
      WRITE(6,5)
      WRITE(6,50)
   50 FORMAT(1H ,'NO MISSIONS PERFORMED')
      WRITE(6,5)
      GO TO 215
   60 WRITE(6,70) Q(7,K)
   70 FORMAT(1H ,'UNUSED CAPACITY (%)            ',F4.0)
      WRITE(6,80) Q(8,K)
   80 FORMAT(1H ,'VEHICLE CUBIC EFFICIENCY (%) ',F4.0)
      WRITE(6,90) Q(9,K)
   90 FORMAT(1H ,'VEHICLE PAYLOAD EFF. (%)      ',F4.0)
      WRITE(6,5)
      WRITE(6,100)
  100 FORMAT(1H ,'CONSIDERING ONLY THE VEHICLES USED AND MISSIONS PERFOR
     *MED-')
      WRITE(6,5)
      WRITE(6,110)
  110 FORMAT(1H ,25X,'TOT. VEH-HRS     PERCENT      AVER/MISSION')
      WRITE(6,120)
  120 FORMAT(1H ,25X,'------------     -------      ------------')
      S=FLOAT(P(8,K)*(P(10,K)-P(9,K)))
      U=0.
      N7=P(7,K)
      DO 130 I=1,N7
      IF(F(I,2,K).EQ.0.) GO TO 130
      U=U+1.
  130 CONTINUE
      U=60.*U
      V=0.
```

```
      DO 140 I=1,6
      V=V+Q(I,K)
  140 CONTINUE
      T1=Q(1,K)/60.
      T2=100.*Q(1,K)/S
      T3=Q(1,K)/U
      WRITE(6,150)
      WRITE(6,1000) T1,T2,T3
  150 FORMAT(1H ,'TRAVEL                ')
      T1=Q(2,K)/60.
      T2=100.*Q(2,K)/S
      T3=Q(2,K)/U
      WRITE(6,160)
      WRITE(6,1000) T1,T2,T3
  160 FORMAT(1H ,'DELAY (DEPT. POINT)   ')
      T1=Q(3,K)/60.
      T2=100.*Q(3,K)/S
      T3=Q(3,K)/U
      WRITE(6,170)
      WRITE(6,1000) T1,T2,T3
  170 FORMAT(1H ,'DELAY (INTERM. POINT)')
      T1=Q(4,K)/60.
      T2=100.*Q(4,K)/S
      T3=Q(4,K)/U
      WRITE(6,180)
      WRITE(6,1000) T1,T2,T3
  180 FORMAT(1H ,'DELAY (RTN POINT)     ')
      T1=Q(5,K)/60.
      T2=100.*Q(5,K)/S
      T3=Q(5,K)/U
      WRITE(6,190)
      WRITE(6,1000) T1,T2,T3
  190 FORMAT(1H ,'LOADING               ')
      T1=Q(6,K)/60.
      T2=100.*Q(6,K)/S
      T3=Q(6,K)/U
      WRITE(6,200)
      WRITE(6,1000) T1,T2,T3
  200 FORMAT(1H ,'UNLOADING             ')
      T1=(S-V)/60.
      T2=100.*(S-V)/S
      T3=(S-V)/U
      WRITE(6,210)
      WRITE(6,1000) T1,T2,T3
  210 FORMAT(1H ,'IDLE                  ')
  215 WRITE(6,5)
      T1=FLOAT(P(10,K)-P(9,K))/60.
      WRITE(6,220) T1
  220 FORMAT(1H ,'HRS FROM FIRST DEPARTURE AND LAST DESIRED ARRIVAL= ',
     * F8.2)
      RETURN
      END
```

```
C***********************************************************************
C
C**** SUBROUTINE PLOT
C          PLOT OUTPUT FOR THE POOL.
C
C***********************************************************************
      SUBROUTINE PLOT(K)
C
C
      DIMENSION  T(100,9,10), A(500,8,10), E(1000,2,10), P(15,10)
      DIMENSION  D(500,8), F(500,2,10), G(18,5)
      DIMENSION  HR(2000), VEH(2000), TON(2000), CUBE(2000), TM(2000)
      DIMENSION  LABEL(4), SS(10), SR(10), RS(10), PP(10)
      DIMENSION  RRR(10), RSS(10), RSR(10), SRS(10)
      INTEGER P
      LEVEL 2, T,A,F,E,D
      COMMON / AAA / T,A,F,E,D
      COMMON / GGG / G
      COMMON / PPP / P
      DATA LABEL/'BUTLER','BLDG 367','X3452','CSD-SMB'/
      NM=P(7,K)
      IF(NM.EQ.0) RETURN
      N2=2*NM
      START=FLOAT(P(9,K))
      FINIS=FLOAT(P(10,K))
      NL=P(6,K)
      T1=0.
      T2=0.
      TV=0.
      TT=0.
      TC=0.
      DO 1100 I=1,N2
      J1=2*I-1
      VEH(J1)=TV
      TON(J1)=TT
      CUBE(J1)=TC
      J2=2*I
      NY=INT(ABS(E(I,2,K)))
      HR(J2)=(E(I,1,K)-START)/60.
      VEH(J2)=TV+SIGN(F(NY,2,K),E(I,2,K))/100.
      TM(J2)=HR(J2)
      IF(E(I,2,K).GT.0.) GO TO 1050
      DO 1025 L=1,NL
      I3=L
      IF(T(L,1,K).EQ.A(NY,1,K)) GO TO 1035
 1025 CONTINUE
 1035 IF(T(I3,9,K).GT.0.) GO TO 1045
      TM(J2)=(E(I,1,K)-(T(I3,7,K)+T(I3,8,K))-START)/60.
 1045 IF(F(NY,2,K).EQ.0.) GO TO 1050
      T1=T1+A(NY,5,K)
      T2=T2+A(NY,6,K)
 1050 TON(J2)=10.*T1/(G(1,2)+G(8,2))
      CUBE(J2)=T2/(G(1,4)+G(8,4))
      HR(J1)=HR(J2)
      TM(J1)=TM(J2)
      TV=VEH(J2)
      TT=TON(J2)
```

```
      TC=CUBE(J2)
 1100 CONTINUE
      N3=2*N2-1
      ENCODE( 50, 1200, SS )
 1200 FORMAT( ' NUMBER OF VEHICLES IN USE VS. TIME>')
      ENCODE( 30, 1300, SR )
 1300 FORMAT( ' NUMBER OF VEHICLES>')
      ENCODE( 30, 1400, RS )
 1400 FORMAT( ' TIME, IN HOURS>')
      ENCODE( 100, 1500, RRR )
 1500 FORMAT( ' SHORT TONS DELIVERED (% OF TOTAL ASSIGNED) VS. TIME>')
      ENCODE( 70, 1600, RSS )
 1600 FORMAT( ' % OF TOTAL SHORT TONS ASSIGNED>')
      ENCODE( 100, 1700, RSR )
 1700 FORMAT( ' CUBIC FEET DELIVERED (% OF TOTAL ASSIGNED) VS. TIME>')
      ENCODE( 50, 1800, SRS )
 1800 FORMAT( ' % OF TOTAL CUBIC FEET ASSIGNED >')
      ENCODE( 40, 1900, PP ) K
 1900 FORMAT( ' POOL NUMBER',I3,'>')
      CALL PLTBEG( 13. , 29. , 1.0 , 13 , LABEL )
      CALL FIXSCA( HR , N3+1 , 8. , XS , XMIN , XMAX , DX )
      CALL FIXSCA( VEH , N3+1 , 6. , YS , YMIN , YMAX , DY )
      CALL PLTSCA( 2. , 2. , XMIN , YMIN , XS , YS )
      CALL PLTDTS( 1 , 0 , HR , VEH , N3+1 , 0 )
      CALL PLTAXS( DX , DY , XMIN , XMAX , YMIN , YMAX , 4 )
      CALL LABELA( DX , DY , XMIN , XMAX , YMIN , YMAX , 1.0 , 1.0 )
      CALL PLTSYM( 0.10 , SS , 0. , XMIN+(XS*2) , YMAX+(YS*0.25) )
      CALL PLTSYM( 0.08 , SR , 90., XMIN-(XS*0.75) , YMIN+(YS*2) )
      CALL PLTSYM( 0.08 , RS , 0. , XMIN+(XS*3) , YMIN-(YS*0.5) )
      CALL PLTSYM( 0.15 , PP , 0. , XMIN+(XS*3.25), YMAX+(YS*0.75) )
C BEGIN PLOT OF SHORT TONS DELIVERED
      CALL FIXSCA( TM , N3+1 , 8. , XS , XMIN , XMAX , DX )
      CALL PLTSCA( 2. , 11. , TM , 0 , XS , 16.66 )
      CALL PLTDTS( 1 , 0 , TM , TON , N3+1 , 0 )
      CALL PLTAXS( DX , 10. , XMIN , XMAX , 0. , 100. , 4 )
      CALL LABELA( DX , 10. , XMIN , XMAX , 0. , 100. , 1.0 , 1.0 )
      CALL PLTSYM( 0.10 , RRR , 0 , XMIN+(XS*1) , 102. )
      CALL PLTSYM( 0.08 , RSS , 90. , XMIN-(XS*0.5) , 20. )
      CALL PLTSYM( 0.08 , RS , 0. , XMIN+(XS*3) , -9. )
      CALL PLTSYM( 0.15 , PP , 0. , XMIN+(XS*3.25) , 108. )
C BEGIN PLOT OF CUBIC FEET DELIV.
      CALL FIXSCA( TM , N3+1 , 8. , XS , XMIN , XMAX , DX )
      CALL PLTSCA( 2. , 20. , TM , 0 , XS , 16.66 )
      CALL PLTDTS( 1 , 0 , TM , CUBE , N3+1 , 0 )
      CALL PLTAXS( DX , 10. , XMIN , XMAX , 0. , 100. , 4)
      CALL LABELA( DX , 10. , XMIN , XMAX , 0. , 100. , 1.0 , 1.0 )
      CALL PLTSYM( 0.10 , RSR , 0. , XMIN+(XS*1) , 102. )
      CALL PLTSYM( 0.08 , SRS , 90. , XMIN-(XS*0.5) , 20. )
      CALL PLTSYM( 0.08 , RS , 0. , XMIN+(XS*3) , -9. )
      CALL PLTSYM( 0.15 , PP , 0. , XMIN+(XS*3.25) , 108. )
      CALL PLTPGE
      RETURN
      END
```


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APPENDIX B

PROGRAM NARRATIVE

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APPENDIX B

PROGRAM NARRATIVE

This appendix consists of a detailed documentation of the TVEM model logic in the form of a nearly line-by-line explanation of the FORTRAN coding. However, portions of the main program that are concerned only with the calculation of statistics and auxiliary subroutines are not documented. Included at various points in the program narrative are line numbers which refer to the program lines of coding as shown at the right hand side of each page in Appendix A.

TVEM PROGRAM NARRATIVE

The program first reads the number of vehicle pools that are to be simulated. If the value is negative, execution ceases. Otherwise, the program checks to ensure that the number of pools is positive and less than or equal to the maximum number of pools permitted. If the constraint is violated, a warning is printed and execution ceases.

If the constraint on the number of pools is satisfied, the program next reads the input data for each pool (loop 40-70).* First, the pool number, vehicle type identification number, the payload for the vehicle in short tons (x10), the cubic capacity, and the number of vehicles assigned to the pool are read. Next, the information on the links for the pool is read (loop 51-55). When a negative number is encountered in the first field of an input card, program control jumps out of the loop and the number of links for the pool is stored. Next, the data on the missions assigned to the pool are read (loop 61-65). When a negative entry is encountered in the first field of an input card, program control jumps out of this loop and the number of missions assigned to the pool is stored. Finally, a parameter called "LIST" is checked and the input information for the pool is printed if and only if the value assigned to the parameter is positive.

After the input information is read for all of the pools, the model begins simulating the missions by processing one pool at a time and in the order of the pools as read in (loop 78-594).

In the first part of the simulation loop (lines 78-179), various data are calculated on the missions to include times of departure and times of return from missions. First, the number of the pool is retrieved and a message is printed. The number of missions assigned to the pool is retrieved. If the number of missions is not positive, the model skips the pool and considers the next one. An auxiliary array for storage of information on the disposition of the remainder of split missions is cleared (loops 83-87), and the number of links for this pool is retrieved.

The model considers each of the missions assigned to the pool (loop 92-150). First, a search is made for the link on which the mission is to occur. If the proper link is not found, a warning is printed and the model skips to consider the next pool. Next, the number of minutes that would be required to accomplish the mission is determined (loop 107-109). Then either the dispatch time or the departure time for the mission is determined. If it is a delivery mission,

*Refers to the line number as shown on the right hand side of the program listing in Appendix A.

the number of minutes required for the vehicles to return to the supply point after having delivered the cargo is dropped from the delivery time. On the other hand, if it is a pickup mission, the time for departure is determined. Next, regardless whether it is a pickup mission or a delivery mission, the time that the vehicles will be available to undertake another mission is determined and stored. The model then calculates the percent capacity of a single vehicle, in terms of cube as well as weight, that is required for the mission cargo, and the more stringent requirement is stored. Finally, after this information for all the missions has been determined, an auxiliary parameter for the sorting routine is set to one.

The event times (departures, deliveries, and returns) are then sorted according to chronological order. If two event times are the same and one is an availability time, the availability event is ranked before the departure or delivery event. After the events are sorted, the earliest delivery or departure time and the latest vehicle availability time are stored.

Before processing each of the events, some auxiliary parameters are initialized. In particular, the program initializes to zero counters for: the number of vehicles occupied performing missions, the number of missions transferred, and the maximum number of vehicles in the pool occupied performing missions throughout the simulation. In addition, an auxiliary parameter used in the event processing is initialized to zero. Next, the parameter for each mission that controls permission to split the mission is examined (loop 173-179). If the control integer "ISP" has been set to zero, all permission parameters are left to remain as read in. If the control integer is -1, permission is given so that any mission can be split when necessary. If, on the other hand, the control integer is +1, no mission will be allowed to be split. Finally, the counter for the total number of missions for the pool is initialized to the number of missions assigned.

Each event is now processed in chronological order (loop 189-487). The index for the event is retrieved and examined to determine whether the event is a mission or a return from a mission. If it is a return, the number of vehicles occupied is lessened by the number of vehicles returning and the model then considers the next event (lines 210-212). On the other hand, if it is a mission, the number of vehicles occupied is increased by the number of vehicles required to undertake the mission. If there are enough vehicles available, the mission is considered completed and the mission disposition code is set to one of several values indicating such. The counter for maximum vehicle utilization is then examined and is set to the larger of its current value or the number of vehicles occupied. The model then considers the next event.

If, however, the pool does not have enough vehicles to accomplish the entire mission, the counter indicating the number of vehicles occupied is reset to its former value and the current mission disposition code is retrieved. Program control then passes to one of five locations depending on the value of the current mission disposition code.

Suppose the mission is an originally assigned mission that may be split. If there are no vehicles at all available to undertake even part of the mission and the mission cannot be transferred, the array element indicating the percent of one vehicle required for the mission (which is really the number of vehicles required multiplied by 100) is reset to zero. The mission disposition code is set to a value indicating a mission skipped in full. After examining the maximum vehicle usage parameter, the next event is considered. If the mission can be transferred to another pool, the mission disposition code is set to a value indicating a mission transferred in full, the counter for the number of missions transferred out of the pool is increased by one, and the mission information is temporarily stored pending later execution of the mission transfer. After examining the maximum vehicle usage parameter, the next event is considered.

On the other hand, if there are some vehicles available to haul part of the mission, processing proceeds as follows. A mission disposition code is set to a value indicating a mission skipped in part, but this could be reset later if the remainder of the mission can be transferred. The counter for the number of missions is incremented by one to reflect the mission being split. The model calculates the amount of the cargo (in tons and cube) that the pool can haul with the vehicles available and stores the number of vehicles that will participate on the split mission (multiplied by 100). The indicator for the number of vehicles occupied is increased by the number of vehicles hauling the cargo for the split mission. Next, the information is stored for the split mission. In particular, the amount of tons and cube that will be delivered is stored and the mission disposition code for this new mission is set to a value indicating a mission completed in part.

For the remainder of the split mission, the amounts of undelivered tons and cube of the cargo are determined and this information is stored in an auxiliary array for later reporting. If the remainder of the mission can be transferred, the information is stored in row one of the array. If it cannot be transferred and thus must be skipped, the information is stored in row two. If the remainder of the mission cannot be transferred, the model simply examines the maximum vehicle usage parameter and proceeds to consider the next event. If the mission can be transferred, the counter for the number of missions transferred out of the pool is increased by one, the mission information (including the remaining tons and cube) is temporarily stored for later execution of the mission transfer, and the mission disposition code is changed to indicate a mission transferred in part. Finally, after examining the maximum vehicle usage parameter, the next event is considered.

Suppose the mission is an originally assigned mission that may not be split. Since the model earlier determined that not enough vehicles are available to undertake the entire mission, only two possible outcomes remain: if the mission cannot be transferred, it will be skipped. To execute this, the model first resets to zero the indicator for the percent capacity of one vehicle in the original pool required for the mission. The mission disposition code is first set to a value indicating a mission skipped in full. If the mission cannot be transferred, the parameter tracking maximum vehicle usage is examined after which the next event is considered. However, if the mission can be transferred, the mission disposition code is changed to a value indicating a mission transferred in full. Then the indicator for the number of missions transferred out of the pool is incremented by one and the mission information is temporarily stored for later execution of transfer. Finally, after examining the maximum vehicle usage parameter, the next event is considered.

Suppose the mission is an additional mission assigned because of a mission transferred in part from another pool. Since the model earlier determined that not enough vehicles are available to undertake the mission, the mission will be skipped. That is, since the mission was transferred in from another pool and represents the remainder of a split mission, it will not be split further. So the transferred remainder must either be completed in full or be skipped in full. Accordingly, the model resets to zero the indicator for how much of the capacity of one vehicle is required for the mission (the number of vehicles required multiplied by 100) and sets the mission disposition code to a value indicating an additionally assigned (as opposed to an originally assigned mission) fractional mission that was skipped. After examining the maximum vehicle usage parameter, the next event is considered.

Suppose the mission is an additional mission assigned because of the transferal of an entire mission from another pool and that splitting is permissible. The model earlier determined that not enough vehicles are available to undertake the whole mission. If there are no vehicles at all available to undertake even part of the mission, the value indicating the percent of the capacity of one vehicle required for the mission is reset to zero. If the mission cannot be transferred to yet another pool, the mission disposition code is set to a value indicating an additionally assigned entire mission that was skipped in full. After examining the parameter indicating maximum vehicle usage, the model considers the next event. On the other hand, if the mission can be transferred, the mission disposition code is set to a value indicating a mission further transferred in full. After incrementing by one the counter for missions transferred out, the mission information is temporarily stored pending later execution of transfer. Finally, after examining the indicator for maximum vehicle usage, the model considers the next event.

If there are some vehicles available to haul part of the mission cargo, processing proceeds as follows. A mission disposition code is set to a value indicating that an additionally assigned entire mission was skipped in part. This may be reset later if the remainder of the split mission can be transferred. The counter for the number of missions is incremented by one to reflect that the mission is being split. The model next determines how much of the cargo (in tons and cube) the pool can haul with the vehicles available and stores the number of vehicles that will participate on the split mission (multiplied by 100). The indicator for the number of vehicles occupied is increased by the number of vehicles hauling the cargo for the split mission. Since all the remaining available vehicles in the pool will be used for the split mission, this means that the indicator will be set to the total number of vehicles in the pool. Next, the information for the split mission is stored including the tons and cube of the cargo that will be delivered. The mission disposition code for this part of the split mission is set to a value indicating an additionally assigned mission completed in part.

For the remainder of the split mission, the undelivered tons and cube of the cargo are determined and stored in an auxiliary array for later reporting. If the remainder of the mission can be transferred to yet another pool, the information is stored in row three of the array. If it cannot be transferred and thus must be skipped, the information is stored in row four. If the remainder of the mission cannot be transferred, the model simply examines the indicator for maximum vehicle usage and proceeds to consider the next event. If the remainder of the mission can be transferred, the counter for the number of missions transferred out of the pool is increased by one, the mission information (including the remaining tons and cube) is temporarily stored pending later execution of transfer, and the mission disposition code is set to a value indicating an additionally assigned mission transferred in part. Finally, after examining the indicator for maximum vehicle usage, the next event is considered.

Suppose the mission is an <u>additional mission assigned because of the transferal of an entire mission</u> from another pool and that <u>splitting is not permissible.</u> The model determined earlier that not enough vehicles are available to undertake the whole mission. Consequently, only two possible mission outcomes remain: if the mission cannot be transferred, it will be skipped. The model first resets to zero the indicator for the percent capacity of a single vehicle required for the mission. Then the mission disposition code is first set to a value indicating an additionally assigned mission skipped in full. If the mission cannot be transferred to yet another pool, the parameter indicating maximum vehicle usage is examined after which the next event is considered. However, if the mission can be transferred, the mission disposition code is set to a value indicating an additionally assigned mission transferred in full. Then the indicator for the number of missions transferred out of the pool is incremented by one and the mission information is temporarily stored pending later execution of mission transfers. Finally, after examining the parameter for maximum vehicle usage, the next event is considered. This exhausts the examination of all possible types of missions and their possible outcomes.

After processing all the events for the pool, the total number of missions assigned to the pool and the maximum number of vehicles in the pool that were occupied at any one time are stored. The model sets to zero the indicator for the percentage capacity of one vehicle required for the mission for all missions that were skipped in part (loop 493-496). The mission events are then resorted to bring into chronological order those additional missions formed because of missions that were split.

In the next program segment (lines 504-533), missions are transferred to other pools. If the pool currently being considered has no missions to be transferred out, this section is skipped. On the other hand, if the pool does have some missions to be transferred, the transfers are executed in the following way. Each of the pools, other than that for which missions are being transferred out, are examined in turn (loop 506-532). For each potential recipient, all of the missions to be transferred are examined (loop 509-531) for those which are be to assigned to the receiving pool. For each such mission, the counter for the number of missions assigned to the receiving pool is incremented by one and the mission information is transferred to the array containing information on missions assigned to the receiving pool (522-524). Before considering the next mission to be transferred to the receiving pool, the mission array element containing the number of the pool to which the mission can be transferred is set to zero (line 530).

The next program segment calculates the vehicle statistics for the pool whose missions have just been processed. Four auxiliary accumulating parameters are set to zero and the array to store the statistics is cleared (loop 543-545). Each of the missions assigned to the pool is considered (loop 547-579). If the mission was skipped or transferred, the next mission is considered. If the mission was undertaken by the pool, the link on which the mission took place is located (loop 549-552). Next, the fraction of the capacity of one vehicle required to haul the mission cargo is determined. (This could be a non-integral value such as 1.75.) This value is accumulated, as is the integral part of the value. The tons and cube of mission cargo are also accumulated. If the fraction of the capacity of one vehicle required for the mission cargo is non-integral, its value is increased to the next higher integral value so that the actual number of vehicles sent on the mission can be determined.

> Example. Suppose the pool has two trucks of 10 tons capacity each and suppose a mission requires delivery of 17.5 tons of cargo. Then 1.75 of the capacity of one truck or 1.75 trucks are required for the mission. Since one cannot send out 3/4 of a truck, two trucks will be sent on the mission. In addition, we see that 2.5 tons of hauling capacity or 12.5 percent of the 20 tons total is unused. (For simplicity I have assumed that the cargo is such that the vehicles "weigh out" before they would "cube out" in the example.)

Next the following values are accumulated:

(a) vehicle-minutes travel time,

(b) vehicle-minutes delay time (departure point),

(c) vehicle-minutes delay time (intermediate point),

(d) vehicle-minutes delay time (return point).

And finally, the vehicle-minutes of load time and the vehicle-minutes of unload time are accumulated. Once the statistics have been totalled for all the missions undertaken by the pool, the following three values are calculated for the pool:

(a) total unused capacity in percent,

(b) cubic efficiency in percent,

(c) weight efficiency in percent.

At this point in the program (line 594), processing of the missions for the pool under current consideration is finished (end of loop 78-594) and program control returns to consider the next pool.

APPENDIX C

EXAMPLE CASE AND INPUT STRUCTURE

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APPENDIX C

EXAMPLE CASE AND INPUT STRUCTURE

In this appendix, a simple example case is developed and the corresponding entries for the links and missions arrays are shown. The appendix also includes a tabulation of the input cards for the case and an illustration of the stacking structure for input to the TVEM. Finally, some notes on the missions arrays are included.

Suppose that it is required to simulate approximately two days of operations of a vehicle fleet consisting of three pools. The first pool, identified as Pool Number 1, is organic to a 155mm howitzer battery. The second, Pool Number 5, is organic to a mechanized infantry battalion. The third pool, Pool Number 2, belongs to a 155mm artillery battalion headquarters and service battery and takes all missions that Pool Number 1 cannot complete.

Pool Number 1 consists of six 5-ton trucks, identified as Type 7, each of which has a cubic capacity of 100 cubic feet. The vehicles are co-located with the firing battery and supply the gun crews by traveling to an ammunition transfer point (ATP), loading, and traveling back to the battery where the ammunition is unloaded. The average speed of the vehicles is 20 kilometers per hour empty and 18 kilometers per hour when carrying a load. The one-way distance from the battery to the ATP is only 20 kilometers, but it increases to 30 kilometers at 0800 hours on the second day when the battery is ordered to a new firing position that is ten kilometers forward. The pool is required to support the relocation of the battery by towing the howitzers and hauling the basic load of ammunition for each howitzer which is five tons and occupies 75 cubic feet. There are six howitzers in a 155mm battery. The pool is also required to deliver 15 tons of ammunition to the battery at 0600 and at 1430 hours on each of the two days. The packaged volume of 155mm ammunition is 15 cubic feet per ton. Automatic loading equipment at the ATP can load the trucks in 20 minutes, but loading or unloading by the truck crews at the firing position invariably requires 30 minutes. Except for the mission to support the battery relocation, all of the missions can be split or transferred to the service battery pool whenever necessary. Missions that can be split are denoted by an entry of 1 in field eight of the missions array. If a mission cannot be split, a 2 should be placed in field eight.

The pool characteristics which are to be punched in 5I5 format on the first input card for this pool are:

pool number - 1,

vehicle type - 7,

payload (short tons x 10) - 50,

capacity (cube) - 100,

number of vehicles - 6.

The entries for the links and missions array for Pool Number 1 are shown in Figure C-1.

Pool Number 5, which supports the mechanized infantry battalion, operates out of the battalion field trains area. The vehicles wait, fully loaded, at the pool for resupply requests from the maneuver battalion. Upon receiving a request, the trucks travel to the battalion, unload, travel back to a supply point to reload, and return to the pool. The distance from the field trains area to the maneuver battalion is five kilometers, but the return portion of the link involves a 15 kilometer trip to the supply point followed by an additional ten kilometer trip to the pool. The pool consists of eight 2 1/2 ton trucks of type 10, each of which has a cubic capacity of 75 cubic feet. The average speed of the trucks is 50 kilometers per hour unloaded and 30 kilometers per hour loaded. Loading or unloading requires 15 minutes. Requests from the maneuver battalion require that 15 tons (450 cubic feet) of supplies be dispatched at 0930 hours on the first day and at 0830 on the second day. It is also necessary to dispatch a mission to haul five tons (300 cubic feet) on each of the two days at 1200 hours. After a slack period, the pool must dispatch a mission to deliver ten tons (450 cubic feet) each evening at 2045 hours to the maneuver battalion. The pool has no higher echelon pool to which missions can be transferred, but the missions can be split with the exception of the daily noontime mission.

The first input card for this pool gives the pool characteristics punched in 5I5 format. The characteristics are:

pool number - 5,

vehicle type - 10,

payload (short tons x 10) - 25,

capacity (cube) - 75,

number of vehicles - 8.

The entries for the links and missions arrays for Pool Number 5 are shown in Figure C-2.

The third pool, Pool Number 2, consists of six trucks of the same type as are in Pool Number 1. Its primary mission is to support the pool that is organic to the 155mm howitzer battery by taking all missions that the firing battery pool cannot accomplish. Its secondary mission is to procure all classes of supplies and deliver them to the firing battery. Accordingly, the pool has only two assigned missions per day. The first is

LINKS ARRAY

LINK NO.	DELAY TIME	LOAD TIME OR ZERO	TRAVEL TIME	DELAY TIME	UNLOAD OR LOAD TIME	TRAVEL TIME	DELAY TIME	LOAD, UNLOAD OR ZERO
1.	0.	0.	60.	0.	20.	67.	0.	30.
2.	0.	30.	33.	0.	30.	0.	0.	0.
3.	0.	0.	90.	0.	20.	100.	0.	30.
-11.								

MISSIONS ARRAY

LINK NO.	DAY	DEPARTURE TIME	DELIVERY TIME	SHORT TONS × 10	CUBIC FEET	TRANSFER POOL NO.	SPLITTING PARAMETER
1.	1.	0.	600.	150.	225.	2.	1.
1.	1.	0.	1430.	150.	225.	2.	1.
1.	2.	0.	600.	150.	225.	2.	1.
2.	2.	800.	0.	300.	450.	0.	2.
3.	2.	0.	1430.	150.	225.	2.	1.
-12.							

Figure C-1. Links and Missions Arrays for Pool Number 1.

LINKS ARRAY

LINK NO.	DELAY TIME	LOAD TIME OR ZERO	TRAVEL TIME	DELAY TIME	UNLOAD OR LOAD TIME	TRAVEL TIME	DELAY TIME	LOAD, UNLOAD OR ZERO
4.	0.	0.	10.	0.	15.	18.	35.	0.
-21.								

MISSIONS ARRAY

LINK NO.	DAY	DEPARTURE TIME	DELIVERY TIME	SHORT TONS × 10	CUBIC FEET	TRANSFER POOL NO.	SPLITTING PARAMETER
4.	1.	930.	0.	150.	450.	0.	1.
4.	1.	1200.	0.	50.	300.	0.	2.
4.	1.	0.	2045.	100.	450.	0.	1.
4.	2.	830.	0.	150.	450.	0.	1.
4.	2.	1200.	0.	50.	300.	0.	2.
4.	2.	0.	2045.	100.	450.	0.	1.
-22.							

Figure C-2. Links and Missions Arrays for Pool Number 5.

a mail delivery to the firing battery which departs at 0900 hours each day. The second mission is to draw Class VI rations and deliver them to the firing battery. In order to ensure the high morale of the firing crews and the personnel in the fire direction center, these rations must arrive at the battery position no later than 1730 hours each day. The cargo for both of these daily missions is negligible in terms of tonnage and cube, and only five minutes is required to load and unload the cargo. The one-way distance from the service battery to the firing battery is only five kilometers until 0800 hours on the second day when the distance increases to 12 kilometers because of the movement of the firing battery. The average speed of the vehicles is 20 kilometers per hour for the two assigned missions. These missions can neither be transferred to another pool nor can they be split. The service battery pool is located adjacent to an ATP. If a mission is transferred from Pool Number 1, the vehicles will load, travel to the firing battery, unload, and return to the service battery pool.

The first input card for this pool consists of the pool characteristics which are the same as those for Pool Number 1. However, the first value on the card, which is the pool identification number, is 2. The entries for the links and missions arrays for Pool Number 2 are given in Figure C-3.

Because this pool can receive missions transferred from Pool Number 1, its input data must not be placed before that of Pool Number 1. Accordingly, the data for Pool Number 2 can be placed in second or third position.

The first input card for the entire input deck must give the number of pools to be simulated which is three for this example. The value should be punched in I5 format in the first field. The last card of the input deck should contain a negative integer punched in the first five columns. All entries in the links and missions arrays must be punched in F8.0 format with all decimal points punched. Figure C-4 shows the general structure of input for the TVEM. The tabulation of the input cards for the example case is given below.

LINKS ARRAY

LINK NO.	DELAY TIME	LOAD TIME OR ZERO	TRAVEL TIME	DELAY TIME	UNLOAD OR LOAD TIME	TRAVEL TIME	DELAY TIME	LOAD, UNLOAD OR ZERO
1.	0.	20.	17.	0.	30.	15.	0.	0.
3.	0.	20.	40.	0.	30.	36.	0.	0.
5.	0.	5.	15.	0.	5.	15.	0.	0.
6.	0.	5.	36.	0.	5.	36.	0.	0.
-31.								

MISSIONS ARRAY

LINK NO.	DAY	DEPARTURE TIME	DELIVERY TIME	SHORT TONS x 10	CUBIC FEET	TRANSFER POOL NO.	SPLITTING PARAMETER
5.	1.	900.	0	1.	1.	0.	2.
5.	1.	0.	1730.	1.	1.	0.	2.
6.	2.	900.	0	1.	1.	0.	2.
6.	2.	0.	1730.	1.	1.	0.	2.
-32.							

Figure C-3 Links and Missions Arrays for Pool Number 2.

******************** INPUT LISTING FOR EXAMPLE CASE ****************************

```
      3
      1     7    50   100     6
  1.       0.       0.       60.      0.       20.      67.      0.       30.
  2.       0.       30.      33.      0.       30.      0.       0.       0.
  3.       0.       0.       90.      0.       20.      100.     0.       30.
-11.
  1.       1.       0.       600.     150.     225.     2.       1.
  1.       1.       0.       1430.    150.     225.     2.       1.
  1.       2.       0.       600.     150.     225.     2.       1.
  2.       2.       800.     0.       300.     450.     0.       2.
  3.       2.       0.       1430.    150.     225.     2.       1.
-12.
      5    10    25    75     8
  4.       0.       0.       10.      0.       15.      18.      35.      0.
-21.
  4.       1.       930.     0.       150.     450.     0.       1.
  4.       1.       1200.    0.       50.      300.     0.       2.
  4.       1.       0.       2045.    100.     450.     0.       1.
  4.       2.       830.     0.       150.     450.     0.       1.
  4.       2.       1200.    0.       50.      300.     0.       2.
  4.       2.       0.       2045.    100.     450.     0.       1.
-22.
      2     7    50   100     6
  1.       0.       20.      17.      0.       30.      15.      0.       0.
  3.       0.       20.      40.      0.       30.      36.      0.       0.
  5.       0.       5.       15.      0.       5.       15.      0.       0.
  6.       0.       5.       36.      0.       5.       36.      0.       0.
-31.
  5.       1.       900.     0.       1.       1.       0.       2.
  5.       1.       0.       1730.    1.       1.       0.       2.
  6.       2.       900.     0.       1.       1.       0.       2.
  6.       2.       0.       1730.    1.       1.       0.       2.
-32.
-9999
```

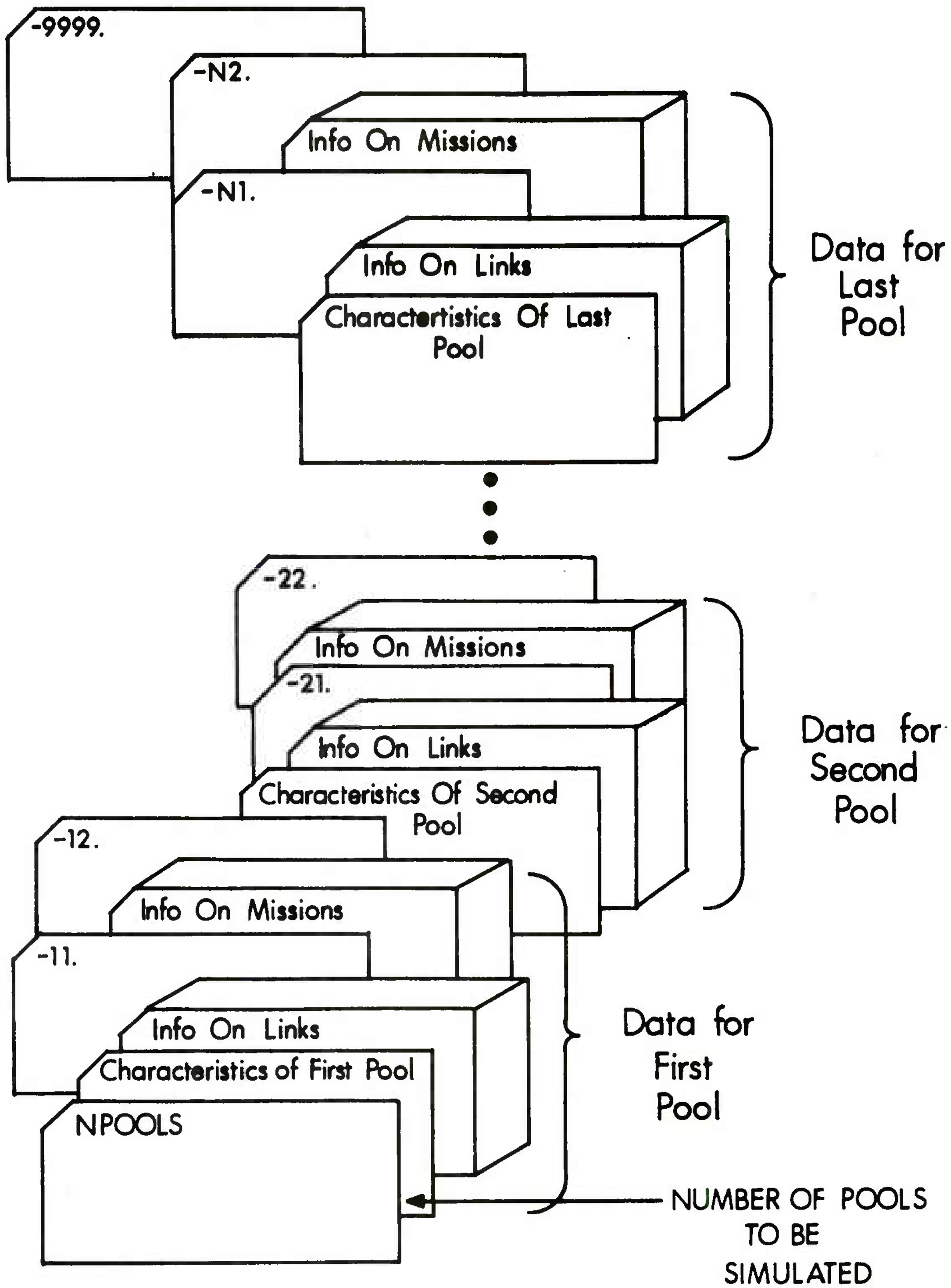

Figure C-4. Input Deck Structure.

Notes On Missions Array

(1) Mission times. The times should be given in 24-hour clock time.

(2) Mission days. Do not input the first day of simulation as day zero. Instead, start with day one.

(3) Mission transfer code. Field seven gives the pool to which the mission can be transferred. Pool identification numbers should be one or two digit, positive numbers. A zero indicates that the mission will not be transferred. An entry of the form "402" signifies that the mission could first be transferred to pool number 2. If pool number 2 cannot complete the mission, it will then be transferred to pool number 4.

(4) Mission transfer. On input for a pool, mission transfers must be coded so as to transfer the missions to pools that will be simulated later in the sequence of pool processing. For example, suppose there are three pools for which the data are input in the order: Pool 1, Pool 2, Pool 3. Missions in Pool 1 could be transferred to either Pool 2 or Pool 3, or both. On the other hand, missions assigned to Pool 2 can be transferred only to Pool 3, not to Pool 1. Moreover, missions assigned to Pool 3 cannot be transferred anywhere.

(5) Mission transfer. If a mission is input for a pool in such a way that it could be transferred to another pool, provision for the link on which the mission is to occur must be made in the receiving pool. Of course, it is to be expected that the travel times, delay times, etc., could be quite different from those in the link input for the first pool.

(6) Mission splitting parameter. The parameter for splitting missions is given in field eight of the missions array. An entry of "1" allows the mission to be split if the pool cannot complete the mission. An entry of "2" denies permission to split the mission.

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APPENDIX D

TEST CASE INPUT AND OUTPUT

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APPENDIX D

TEST CASE INPUT AND OUTPUT

Because the example case given in Appendix C is rather simple in terms of the output that would be generated by the TVEM, it was decided to report on a more complicated test case in this Appendix. The test case whose input and output are described herein was that which was used to test the translated version of the model. It was designed so as to exercise the model quite fully and, hence, yields output that is much more interesting than that which would result from the simulation of the example case in Appendix C.

Test Case Input

According to the first input card, the data for this test case consist of information on five vehicle pools. The important points regarding the input data for each of the vehicle pools are given in the following paragraphs.

The second input card identifies the first pool as Pool Number 1. This pool consists of two trucks of Type Number 7 each of which can haul 1/2 ton or 100 cubic feet of cargo. The next six cards give the information on the links on which any missions assigned to this pool are to occur. For the first three links we see that the zeros in field nine denote that missions on these links will be delivery missions. On the other hand, the zeros in field three for the last three links denote that missions on these links will be pickup missions. Finally, the data for the links are terminated by a negative number in the first field of the ninth card.

The next nine cards comprise the schedule of missions assigned to the pool. The missions are scheduled to occur at various times over a two day period. Notice that if the departure time is specified for a mission, the value in the field for the delivery time is zero, and vice-versa. All of the missions except the third, eighth, and ninth can be split if necessary. With the exception of the first, fourth, and seventh missions, all can be transferred to another pool if necessary. In that event the missions will be transferred to a pool identified as Pool Number 4. If Pool Number 4 cannot complete these missions, they will be transferred to Pool Number 5. However, with the override in effect to prevent this, any such missions will be skipped by Pool Number 4. The amounts of tonnage and volume of the cargo for each mission are given in fields five and six, respectively. For example, for the first listed mission, one-tenth ton of cargo occupying ten cubic feet must be delivered on the first day at 1:27 A.M. The mission cannot be transferred, but may be split. (Because of the capacity of the two trucks assigned to this pool compared to the small amount of cargo for this mission, it will not be split, however.) Finally, the mission is to be hauled on Link Number 1. According to the second listed mission, one short ton of cargo occupying 70 cubic feet is to be delivered on Link Number 2. The vehicles are to depart from the pool at 8:30 A.M. on the first day. The mission can be split if only one of the two vehicles is available at the scheduled time and the remaining half-ton of mission cargo would be transferred to Pool Number 4. Or, if neither of the vehicles is available, the entire mission will be transferred to Pool Number 4. The remaining seven missions are similar. The mission schedule is terminated by the negative number in the first field of the nineteenth card. This concludes the input data for the first pool.

The data for the second and third pools follow those for the first pool and are of a similar nature. The data for Pool Number 4, however, are somewhat different. Only three missions are assigned to this pool, all of which are to occur on Link Number 16. However, the list of links contains data for sixteen links. This reflects the fact that the pool might be assigned additional missions in support of the first three vehicle pools. Because any mission transferred to Pool Number 4 could be designated to occur on any one of the other fifteen links, provision for this situation must be made by including data for them in the list of links.

Pool Number 5, with five trucks of two tons and 500 cubic feet capacity each, has no assigned missions. However, without the override that prevents secondary transfer of missions, additional missions could be assigned to this pool resulting from transferral of some of the missions that were first transferred to Pool Number 4 from those that were originally assigned to the first three pools. Therefore, data are provided for sixteen links although it was not necessary to do so. With no missions originally assigned and no possibility of additional mission assignments, our test case results for Pool Number 5 should show that no missions were undertaken.

The input data for the test case simulation of five pools is terminated by a card with a negative integer in the first five columns. Without the terminator card it would be possible to input data for a second case to be run as a separate simulation in the same run stream.

```
     5
      1       7      5    100       2
  1.      1.      1.      1.      6.      6.      1.      6.      0.
  2.      2.      2.      2.      5.      5.      2.      5.      0.
  3.      3.      3.      3.      4.      4.      3.      4.      0.
  4.      4.      0.      4.      3.      3.      4.      3.      3.
  5.      5.      0.      5.      2.      2.      5.      2.      2.
  6.      6.      0.      6.      1.      1.      6.      1.      1.
-100001.
   1.     1.      0.      127.    1.      10.     0.      1.
   2.     1.      830.    0.      10.     70.     504.    1.
   4.     1.      0.      200.    1.      300.    504.    2.
   5.     1.      0.      115.    3.      30.     0.      1.
   6.     1.      115.    0.      30.     150.    504.    1.
   1.     2.      815.    0.      20.     100.    504.    1.
   3.     2.      0.      115.    2.      20.     0.      1.
   4.     2.      330.    0.      15.     50.     504.    2.
   4.     2.      0.      135.    5.      100.    504.    2.
-100002.
     2       8     10    200       5
  7.      11.     11.     10.     7.      20.     10.     5.      0.
  8.      10.     10.     15.     8.      15.     15.     5.      0.
  9.      9.      9.      10.     9.      15.     10.     5.      0.
  10.     8.      0.      15.     10.     20.     15.     5.      8.
  11.     7.      0.      10.     11.     20.     10.     5.      7.
-200001.
  7.      1.      30.     0.      5.      100.    0.      2.
  11.     1.      0.      200.    20.     450.    504.    1.
  8.      1.      530.    0.      50.     800.    504.    1.
  10.     1.      0.      1000.   100.    1000.   504.    2.
  9.      1.      1400.   0.      50.     1100.   504.    2.
  7.      2.      500.    0.      150.    1000.   504.    1.
  11.     2.      0.      1100.   15.     400.    504.    1.
  8.      2.      1230.   0.      25.     400.    504.    1.
  10.     2.      0.      1615.   40.     850.    504.    1.
  9.      2.      2000.   0.      30.     500.    0.      2.
  7.      3.      0.      900.    80.     1500.   504.    1.
-200002.
     3       9     10    200       5
  12.     15.     15.     10.     12.     5.      10.     5.      0.
  13.     14.     14.     15.     13.     7.      15.     5.      0.
  14.     13.     0.      10.     14.     5.      10.     5.      13.
  15.     12.     0.      15.     15.     7.      15.     5.      12.
-300001.
  12.     0.      0.      1700.   5.      50.     504.    2.
  13.     0.      0.      2000.   40.     100.    504.    2.
  14.     0.      830.    0.      50.     50.     504.    1.
  15.     0.      1400.   0.      100.    100.    504.    1.
  12.     0.      0.      2400.   20.     50.     504.    1.
  13.     1.      0.      100.    80.     100.    504.    1.
  14.     1.      1000.   0.      30.     50.     504.    1.
  15.     1.      1300.   0.      10.     100.    504.    1.
  12.     2.      0.      500.    100.    50.     504.    1.
  13.     2.      0.      600.    20.     200.    504.    1.
  14.     2.      0.      900.    40.     100.    504.    1.
```

```
15.     2.      1400.   0.      50.     200.    504.    1.
12.     3.      30.     0.      30.     100.    504.    1.
12.     3.      100.    0.      150.    1000.   504.    1.
12.     3.      115.    0.      150.    1000.   504.    1.
12.     3.      130.    0.      200.    1200.   504.    2.
12.     3.      230.    0.      200.    1200.   504.    2.
12.     3.      300.    0.      150.    1000.   504.    1.
-300002.
    4   10   20   500    6
1.      0.      0.      5.      0.      7.      5.      15.     0.
2.      0.      0.      16.     0.      8.      6.      8.      0.
3.      0.      0.      7.      0.      9.      7.      15.     0.
4.      0.      0.      18.     0.      9.      8.      9.      0.
5.      0.      0.      9.      0.      8.      9.      15.     0.
6.      0.      0.      20.     0.      7.      10.     7.      0.
7.      0.      0.      10.     0.      6.      10.     15.     0.
8.      0.      0.      19.     0.      6.      9.      6.      0.
9.      0.      0.      8.      0.      7.      8.      15.     0.
10.     0.      0.      17.     0.      8.      7.      8.      0.
11.     0.      0.      6.      0.      9.      6.      15.     0.
12.     0.      0.      15.     0.      10.     5.      10.     0.
13.     0.      0.      5.      0.      5.      5.      15.     0.
14.     0.      0.      20.     0.      5.      10.     5.      0.
15.     0.      0.      15.     0.      5.      10.     15.     0.
16.     0.      0.      10.     0.      5.      10.     0.      5.
-400001.
16.     0.      800.    0.      5.      100.    0.      2.
16.     1.      800.    0.      5.      100.    0.      2.
16.     2.      800.    0.      5.      100.    0.      2.
-400002.
    5   10   20   500    5
1.      0.      0.      5.      0.      7.      5.      15.     0.
2.      0.      0.      16.     0.      8.      6.      8.      0.
3.      0.      0.      7.      0.      9.      7.      15.     0.
4.      0.      0.      18.     0.      9.      8.      9.      0.
5.      0.      0.      9.      0.      8.      9.      15.     0.
6.      0.      0.      20.     0.      7.      10.     7.      0.
7.      0.      0.      10.     0.      6.      10.     15.     0.
8.      0.      0.      19.     0.      6.      9.      6.      0.
9.      0.      0.      8.      0.      7.      8.      15.     0.
10.     0.      0.      17.     0.      8.      7.      8.      0.
11.     0.      0.      6.      0.      9.      6.      15.     0.
12.     0.      0.      15.     0.      10.     5.      10.     0.
13.     0.      0.      5.      0.      5.      5.      15.     0.
14.     0.      0.      20.     0.      5.      10.     5.      0.
15.     0.      0.      15.     0.      5.      10.     15.     0.
16.     0.      0.      10.     0.      5.      10.     5.      0.
-500001.
-500002.
-9999
```

Test Case Output

The first five pages of output from the test case simulation are listings of the input data for each of the five pools, to include the pool characteristics and the links and missions arrays for each.

The next five pages of output give the simulation results by pool. Because Pool Number 4 is, perhaps, the most interesting, its output will be discussed in detail. In addition to a short listing of the characteristics of the pool, the output for each pool consists of a Mission Status Report and a Vehicle Status Report.

In the Mission Status Report, the information concerning the disposition of missions is divided into two mission categories: original missions assigned and additional missions assigned. For this pool three missions were originally assigned and seventeen were additionally assigned. The three original missions required a total of 1.5 short tons to be hauled and the cargo occupied 300 cubic feet total volume. The 1.5 short tons represents 1.2 percent of the total mission tonnage assigned in both categories and the 300 cubic feet represents 3.2 percent of the total cargo volume. All three original missions were completed in full.

The additional missions are subdivided into two categories: fractional missions and whole missions. The fractional missions result from the transferal from the first three pools of the remainders of split missions. Of the seventeen additional missions, nine were fractional missions and the remaining eight were whole missions. Of the nine fractional missions, seven were completed and two were not. Because fractional missions can neither be split further nor transferred to another pool, it was necessary to skip these two missions. Of the eight whole missions, five were completed in full and two were skipped in full. The remaining mission was completed in part and the remainder of this split mission was skipped. Because of the override preventing transferal of additionally assigned missions to another pool, the whole missions that could not be completed were skipped as was the remainder of the split mission.

As in the case of original missions assigned, information is printed for each of the disposition categories under the additional missions assigned. This consists of the number of short tons and volume of cargo as well as the percentages of the totals that each represents.

Under the Vehicle Status Report the first item of information reported is the number of vehicles used. Here we see that during at least some portion of the simulation of Pool Number 4, all six trucks were occupied performing missions. The percent unused capacity, which is seventeen percent for this pool, is the per-mission average percent of underutilization of the hauling capacity of the trucks. A truck is underutilized whenever the amount of cargo specified by a mission request requires the dispatching of an additional truck, even though only a fraction of its capacity is required to complete the mission. The percent cubic efficiency and percent vehicle payload efficiency represent the per-mission average degree of mismatch between the configuration of the truck in terms of its weight versus volume capacity and the weight versus volume of the cargo to be hauled.

The last table in the Vehicle Status Report gives the total number of vehicle-hours that the trucks spent in each of the activity categories shown. Notice that many of the six vehicles in this pool spent a large amount of time idle. Because the number of hours from first departure to last desired arrival was 73.42, the total number of vehicle-hours amounts to 440.42. Therefore, the 415.4 vehicle-hours in the idle category represents 94.3 percent of the total. Recalling from the Mission Status Report that sixteen missions were completed, we see that the 415.4 vehicle-hours in the idle category represent an average of 25.96 vehicle-hours per mission. The percentages and per-mission averages for the other six activity categories are determined similarly.

POOL NUMBER	1
VEHICLE NUMBER	7
VEH. PAY.(STX10)	5
VEH. CUBIC CAP.	100
NO. OF VEHICLES	2
NUMBER OF LINKS	6
NO. OF MISSIONS	9

LINKS

T(R,C)	C1	C2	C3	C4	C5	C6	C7	C8	C9
R 1 /	1.0	1.0	1.0	1.0	6.0	6.0	1.0	6.0	0.0
R 2 /	2.0	2.0	2.0	2.0	5.0	5.0	2.0	5.0	0.0
R 3 /	3.0	3.0	3.0	3.0	4.0	4.0	3.0	4.0	0.0
R 4 /	4.0	4.0	0.0	4.0	3.0	3.0	4.0	3.0	3.0
R 5 /	5.0	5.0	0.0	5.0	2.0	2.0	5.0	2.0	2.0
R 6 /	6.0	6.0	0.0	6.0	1.0	1.0	6.0	1.0	1.0

MISSIONS

A(R,C)	C1	C2	C3	C4	C5	C6	C7	C8
R 1 /	1.0	1.0	0.0	127.0	1.0	10.0	0.0	1.0
R 2 /	2.0	1.0	830.0	0.0	10.0	70.0	504.0	1.0
R 3 /	4.0	1.0	0.0	200.0	1.0	300.0	504.0	2.0
R 4 /	5.0	1.0	0.0	115.0	3.0	30.0	0.0	1.0
R 5 /	6.0	1.0	115.0	0.0	30.0	150.0	504.0	1.0
R 6 /	1.0	2.0	815.0	0.0	20.0	100.0	504.0	1.0
R 7 /	3.0	2.0	0.0	115.0	2.0	20.0	0.0	1.0
R 8 /	4.0	2.0	330.0	0.0	15.0	50.0	504.0	2.0
R 9 /	4.0	2.0	0.0	135.0	5.0	100.0	504.0	2.0

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POOL NUMBER	2
VEHICLE NUMBER	8
VEH. PAY.(STX10)	10
VEH. CUBIC CAP.	200
NO. OF VEHICLES	5
NUMBER OF LINKS	5
NO. OF MISSIONS	11

LINKS

T(R,C)	C1	C2	C3	C4	C5	C6	C7	C8	C9
R 1 /	7.0	11.0	11.0	10.0	7.0	20.0	10.0	5.0	0.0
R 2 /	8.0	10.0	10.0	15.0	8.0	15.0	15.0	5.0	0.0
R 3 /	9.0	9.0	9.0	10.0	9.0	15.0	10.0	5.0	0.0
R 4 /	10.0	8.0	0.0	15.0	10.0	20.0	15.0	5.0	8.0
R 5 /	11.0	7.0	0.0	10.0	11.0	20.0	10.0	5.0	7.0

MISSIONS

A(R,C)	C1	C2	C3	C4	C5	C6	C7	C8
R 1 /	7.0	1.0	30.0	0.0	5.0	100.0	0.0	2.0
R 2 /	11.0	1.0	0.0	200.0	20.0	450.0	504.0	1.0
R 3 /	8.0	1.0	530.0	0.0	50.0	800.0	504.0	1.0
R 4 /	10.0	1.0	0.0	1000.0	100.0	1000.0	504.0	2.0
R 5 /	9.0	1.0	1400.0	0.0	50.0	1100.0	504.0	2.0
R 6 /	7.0	2.0	500.0	0.0	150.0	1000.0	504.0	1.0
R 7 /	11.0	2.0	0.0	1100.0	15.0	400.0	504.0	1.0
R 8 /	8.0	2.0	1230.0	0.0	25.0	400.0	504.0	1.0
R 9 /	10.0	2.0	0.0	1615.0	40.0	850.0	504.0	1.0
R 10 /	9.0	2.0	2000.0	0.0	30.0	500.0	0.0	2.0
R 11 /	7.0	3.0	0.0	900.0	80.0	1500.0	504.0	1.0

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POOL NUMBER	3
VEHICLE NUMBER	9
VEH. PAY.(STX10)	10
VEH. CUBIC CAP.	200
NO. OF VEHICLES	5
NUMBER OF LINKS	4
NO. OF MISSIONS	18

LINKS

T(R,C)	C1	C2	C3	C4	C5	C6	C7	C8	C9
R 1 /	12.0	15.0	15.0	10.0	12.0	5.0	10.0	5.0	0.0
R 2 /	13.0	14.0	14.0	15.0	13.0	7.0	15.0	5.0	0.0
R 3 /	14.0	13.0	0.0	10.0	14.0	5.0	10.0	5.0	13.0
R 4 /	15.0	12.0	0.0	15.0	15.0	7.0	15.0	5.0	12.0

MISSIONS

A(R,C)	C1	C2	C3	C4	C5	C6	C7	C8
R 1 /	12.0	0.0	0.0	1700.0	5.0	50.0	504.0	2.0
R 2 /	13.0	0.0	0.0	2000.0	40.0	100.0	504.0	2.0
R 3 /	14.0	0.0	830.0	0.0	50.0	50.0	504.0	1.0
R 4 /	15.0	0.0	1400.0	0.0	100.0	100.0	504.0	1.0
R 5 /	12.0	0.0	0.0	2400.0	20.0	50.0	504.0	1.0
R 6 /	13.0	1.0	0.0	100.0	80.0	100.0	504.0	1.0
R 7 /	14.0	1.0	1000.0	0.0	30.0	50.0	504.0	1.0
R 8 /	15.0	1.0	1300.0	0.0	10.0	100.0	504.0	1.0
R 9 /	12.0	2.0	0.0	500.0	100.0	50.0	504.0	1.0
R 10 /	13.0	2.0	0.0	600.0	20.0	200.0	504.0	1.0
R 11 /	14.0	2.0	0.0	900.0	40.0	100.0	504.0	1.0
R 12 /	15.0	2.0	1400.0	0.0	50.0	200.0	504.0	1.0
R 13 /	12.0	3.0	30.0	0.0	30.0	100.0	504.0	1.0
R 14 /	12.0	3.0	100.0	0.0	150.0	1000.0	504.0	1.0
R 15 /	12.0	3.0	115.0	0.0	150.0	1000.0	504.0	1.0
R 16 /	12.0	3.0	130.0	0.0	200.0	1200.0	504.0	2.0
R 17 /	12.0	3.0	230.0	0.0	200.0	1200.0	504.0	2.0
R 18 /	12.0	3.0	300.0	0.0	150.0	1000.0	504.0	1.0

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POOL NUMBER	4
VEHICLE NUMBER	10
VEH. PAY.(STX10)	20
VEH. CUBIC CAP.	500
NO. OF VEHICLES	6
NUMBER OF LINKS	16
NO. OF MISSIONS	3

LINKS

T(R,C)	C1	C2	C3	C4	C5	C6	C7	C8	C9
R 1 /	1.0	0.0	0.0	5.0	0.0	7.0	5.0	15.0	0.0
R 2 /	2.0	0.0	0.0	16.0	0.0	8.0	6.0	8.0	0.0
R 3 /	3.0	0.0	0.0	7.0	0.0	9.0	7.0	15.0	0.0
R 4 /	4.0	0.0	0.0	18.0	0.0	9.0	8.0	9.0	0.0
R 5 /	5.0	0.0	0.0	9.0	0.0	8.0	9.0	15.0	0.0
R 6 /	6.0	0.0	0.0	20.0	0.0	7.0	10.0	7.0	0.0
R 7 /	7.0	0.0	0.0	10.0	0.0	6.0	10.0	15.0	0.0
R 8 /	8.0	0.0	0.0	19.0	0.0	6.0	9.0	6.0	0.0
R 9 /	9.0	0.0	0.0	8.0	0.0	7.0	8.0	15.0	0.0
R 10 /	10.0	0.0	0.0	17.0	0.0	8.0	7.0	8.0	0.0
R 11 /	11.0	0.0	0.0	6.0	0.0	9.0	6.0	15.0	0.0
R 12 /	12.0	0.0	0.0	15.0	0.0	10.0	5.0	10.0	0.0
R 13 /	13.0	0.0	0.0	5.0	0.0	5.0	5.0	15.0	0.0
R 14 /	14.0	0.0	0.0	20.0	0.0	5.0	10.0	5.0	0.0
R 15 /	15.0	0.0	0.0	15.0	0.0	5.0	10.0	15.0	0.0
R 16 /	16.0	0.0	0.0	10.0	0.0	5.0	10.0	0.0	5.0

MISSIONS

A(R,C)	C1	C2	C3	C4	C5	C6	C7	C8
R 1 /	16.0	0.0	800.0	0.0	5.0	100.0	0.0	2.0
R 2 /	16.0	1.0	800.0	0.0	5.0	100.0	0.0	2.0
R 3 /	16.0	2.0	800.0	0.0	5.0	100.0	0.0	2.0

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POOL NUMBER	5
VEHICLE NUMBER	10
VEH. PAY.(STX10)	20
VEH. CUBIC CAP.	500
NO. OF VEHICLES	5
NUMBER OF LINKS	16
NO. OF MISSIONS	0

LINKS

T(R,C)	C1	C2	C3	C4	C5	C6	C7	C8	C9
R 1	1.0	0.0	0.0	5.0	0.0	7.0	5.0	15.0	0.0
R 2	2.0	0.0	0.0	16.0	0.0	8.0	6.0	8.0	0.0
R 3	3.0	0.0	0.0	7.0	0.0	9.0	7.0	15.0	0.0
R 4	4.0	0.0	0.0	18.0	0.0	9.0	8.0	9.0	0.0
R 5	5.0	0.0	0.0	9.0	0.0	8.0	9.0	15.0	0.0
R 6	6.0	0.0	0.0	20.0	0.0	7.0	10.0	7.0	0.0
R 7	7.0	0.0	0.0	10.0	0.0	6.0	10.0	15.0	0.0
R 8	8.0	0.0	0.0	19.0	0.0	6.0	9.0	6.0	0.0
R 9	9.0	0.0	0.0	8.0	0.0	7.0	8.0	15.0	0.0
R 10	10.0	0.0	0.0	17.0	0.0	8.0	7.0	8.0	0.0
R 11	11.0	0.0	0.0	6.0	0.0	9.0	6.0	15.0	0.0
R 12	12.0	0.0	0.0	15.0	0.0	10.0	5.0	10.0	0.0
R 13	13.0	0.0	0.0	5.0	0.0	5.0	5.0	15.0	0.0
R 14	14.0	0.0	0.0	20.0	0.0	5.0	10.0	5.0	0.0
R 15	15.0	0.0	0.0	15.0	0.0	5.0	10.0	15.0	0.0
R 16	16.0	0.0	0.0	10.0	0.0	5.0	10.0	5.0	0.0

MISSIONS

A(R,C)	C1	C2	C3	C4	C5	C6	C7	C8

NO MISSIONS ASSIGNED

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OUTPUT FOR POOL NO.	1
VEHICLE NUMBER	7
VEHICLE PAYLOAD (STX10)	5
VEHICLE CUBIC CAPACITY	100
NO. OF VEHICLES IN POOL	2

M I S S I O N   S T A T U S   R E P O R T

	NO.	S.T.	% ST	100 CF	% CF
1) ORIGINAL MISSIONS ASSIGNED	9.	8.7	100.0	8.3	100.0
COMPLETED IN FULL	5.	2.1	24.1	2.3	27.7
CONTRACTED IN FULL	2.	1.6	18.4	3.5	42.2
SKIPPED IN FULL	0.	0.0	0.0	0.0	0.0
COMPLETED IN PART	2.	1.5	17.2	.8	9.0
CONTRACTED IN PART	2.	3.5	40.2	1.8	21.1
SKIPPED IN PART	0.	0.0	0.0	0.0	0.0
2) ADDITIONAL MISSIONS ASSIGNED	0.	0.0	0.0	0.0	0.0
FRACTIONAL MISSIONS	0.	0.0	0.0	0.0	0.0
COMPLETED	0.	0.0	0.0	0.0	0.0
SKIPPED	0.	0.0	0.0	0.0	0.0
WHOLE MISSIONS	0.	0.0	0.0	0.0	0.0
COMPLETED IN FULL	0.	0.0	0.0	0.0	0.0
CONTRACTED IN FULL	0.	0.0	0.0	0.0	0.0
SKIPPED IN FULL	0.	0.0	0.0	0.0	0.0
COMPLETED IN PART	0.	0.0	0.0	0.0	0.0
CONTRACTED IN PART	0.	0.0	0.0	0.0	0.0
SKIPPED IN PART	0.	0.0	0.0	0.0	0.0

V E H I C L E   S T A T U S   R E P O R T

NO. OF VEHICLES USED	2
UNUSED CAPACITY (%)	20.
VEHICLE CUBIC EFFICIENCY (%)	42.
VEHICLE PAYLOAD EFF. (%)	100.

CONSIDERING ONLY THE VEHICLES USED AND MISSIONS PERFORMED-

	TOT. VEH-HRS	PERCENT	AVER/MISSION
TRAVEL	.8	1.3	.12
DELAY (DEPT. POINT)	.4	.7	.06
DELAY (INTERM. POINT)	.6	1.0	.09
DELAY (RTN POINT)	.6	1.0	.09
LOADING	.3	.4	.04
UNLOADING	.6	1.0	.09
IDLE	60.1	94.6	8.58

HRS FROM FIRST DEPARTURE AND LAST DESIRED ARRIVAL= 31.75

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OUTPUT FOR POOL NO. 2
VEHICLE NUMBER 8
VEHICLE PAYLOAD (STX10) 10
VEHICLE CUBIC CAPACITY 200
NO. OF VEHICLES IN POOL 5

M I S S I O N   S T A T U S   R E P O R T

	NO.	S.T.	% ST	100 CF	% CF
1) ORIGINAL MISSIONS ASSIGNED	11.	56.5	100.0	81.0	100.0
COMPLETED IN FULL	7.	18.5	32.7	35.0	43.2
CONTRACTED IN FULL	2.	15.0	26.5	21.0	25.9
SKIPPED IN FULL	0.	0.0	0.0	0.0	0.0
COMPLETED IN PART	2.	10.0	17.7	12.7	15.7
CONTRACTED IN PART	2.	13.0	23.0	12.3	15.2
SKIPPED IN PART	0.	0.0	0.0	0.0	0.0
2) ADDITIONAL MISSIONS ASSIGNED	0.	0.0	0.0	0.0	0.0
FRACTIONAL MISSIONS	0.	0.0	0.0	0.0	0.0
COMPLETED	0.	0.0	0.0	0.0	0.0
SKIPPED	0.	0.0	0.0	0.0	0.0
WHOLE MISSIONS	0.	0.0	0.0	0.0	0.0
COMPLETED IN FULL	0.	0.0	0.0	0.0	0.0
CONTRACTED IN FULL	0.	0.0	0.0	0.0	0.0
SKIPPED IN FULL	0.	0.0	0.0	0.0	0.0
COMPLETED IN PART	0.	0.0	0.0	0.0	0.0
CONTRACTED IN PART	0.	0.0	0.0	0.0	0.0
SKIPPED IN PART	0.	0.0	0.0	0.0	0.0

V E H I C L E   S T A T U S   R E P O R T

NO. OF VEHICLES USED 5
UNUSED CAPACITY (%) 8.
VEHICLE CUBIC EFFICIENCY (%) 81.
VEHICLE PAYLOAD EFF. (%) 97.

CONSIDERING ONLY THE VEHICLES USED AND MISSIONS PERFORMED-

	TOT. VEH-HRS	PERCENT	AVER/MISSION
TRAVEL	12.8	4.5	1.43
DELAY (DEPT. POINT)	5.1	1.8	.56
DELAY (INTERM. POINT)	4.6	1.6	.51
DELAY (RTN POINT)	2.7	.9	.30
LOADING	7.1	2.5	.79
UNLOADING	7.7	2.7	.85
IDLE	243.9	85.9	27.09

HRS FROM FIRST DEPARTURE AND LAST DESIRED ARRIVAL= 56.75
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

OUTPUT FOR POOL NO.	3
VEHICLE NUMBER	9
VEHICLE PAYLOAD (STX10)	10
VEHICLE CUBIC CAPACITY	200
NO. OF VEHICLES IN POOL	5

M I S S I O N   S T A T U S   R E P O R T

	NO.	S.T.	% ST	100 CF	% CF
1) ORIGINAL MISSIONS ASSIGNED	18.	142.5	100.0	66.5	100.0
COMPLETED IN FULL	9.	27.5	19.3	8.0	12.0
CONTRACTED IN FULL	4.	57.0	40.0	36.0	54.1
SKIPPED IN FULL	0.	0.0	0.0	0.0	0.0
COMPLETED IN PART	5.	20.0	14.0	5.8	8.7
CONTRACTED IN PART	5.	38.0	26.7	16.7	25.1
SKIPPED IN PART	0.	0.0	0.0	0.0	0.0
2) ADDITIONAL MISSIONS ASSIGNED	0.	0.0	0.0	0.0	0.0
FRACTIONAL MISSIONS	0.	0.0	0.0	0.0	0.0
COMPLETED	0.	0.0	0.0	0.0	0.0
SKIPPED	0.	0.0	0.0	0.0	0.0
WHOLE MISSIONS	0.	0.0	0.0	0.0	0.0
COMPLETED IN FULL	0.	0.0	0.0	0.0	0.0
CONTRACTED IN FULL	0.	0.0	0.0	0.0	0.0
SKIPPED IN FULL	0.	0.0	0.0	0.0	0.0
COMPLETED IN PART	0.	0.0	0.0	0.0	0.0
CONTRACTED IN PART	0.	0.0	0.0	0.0	0.0
SKIPPED IN PART	0.	0.0	0.0	0.0	0.0

V E H I C L E   S T A T U S   R E P O R T

NO. OF VEHICLES USED	5
UNUSED CAPACITY (%)	1.
VEHICLE CUBIC EFFICIENCY (%)	15.
VEHICLE PAYLOAD EFF. (%)	100.

CONSIDERING ONLY THE VEHICLES USED AND MISSIONS PERFORMED-

	TOT. VEH-HRS	PERCENT	AVER/MISSION
TRAVEL	19.0	5.6	1.36
DELAY (DEPT. POINT)	10.9	3.2	.78
DELAY (INTERM. POINT)	10.7	3.2	.76
DELAY (RTN POINT)	4.0	1.2	.29
LOADING	8.4	2.5	.60
UNLOADING	7.1	2.1	.51
IDLE	278.4	82.2	19.88

HRS FROM FIRST DEPARTURE AND LAST DESIRED ARRIVAL= 67.70

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX)

OUTPUT FOR POOL NO.	4
VEHICLE NUMBER	10
VEHICLE PAYLOAD (STX10)	20
VEHICLE CUBIC CAPACITY	500
NO. OF VEHICLES IN POOL	6

M I S S I O N   S T A T U S   R E P O R T

	NO.	S.T.	% ST	100 CF	% CF
1) ORIGINAL MISSIONS ASSIGNED	3.	1.5	1.2	3.0	3.2
COMPLETED IN FULL	3.	1.5	1.2	3.0	3.2
CONTRACTED IN FULL	0.	0.0	0.0	0.0	0.0
SKIPPED IN FULL	0.	0.0	0.0	0.0	0.0
COMPLETED IN PART	0.	0.0	0.0	0.0	0.0
CONTRACTED IN PART	0.	0.0	0.0	0.0	0.0
SKIPPED IN PART	0.	0.0	0.0	0.0	0.0
2) ADDITIONAL MISSIONS ASSIGNED	17.	128.1	98.8	91.3	96.8
FRACTIONAL MISSIONS	9.	54.5	42.1	30.8	32.6
COMPLETED	7.	31.5	24.3	15.4	16.4
SKIPPED	2.	23.0	17.7	15.3	16.3
WHOLE MISSIONS	8.	73.6	56.8	60.5	64.2
COMPLETED IN FULL	5.	18.6	14.4	26.5	28.1
CONTRACTED IN FULL	0.	0.0	0.0	0.0	0.0
SKIPPED IN FULL	2.	40.0	30.9	24.0	25.5
COMPLETED IN PART	1.	12.0	9.3	8.0	8.5
CONTRACTED IN PART	0.	0.0	0.0	0.0	0.0
SKIPPED IN PART	1.	3.0	2.3	2.0	2.1

V E H I C L E   S T A T U S   R E P O R T

NO. OF VEHICLES USED	6
UNUSED CAPACITY (%)	17.
VEHICLE CUBIC EFFICIENCY (%)	33.
VEHICLE PAYLOAD EFF. (%)	98.

CONSIDERING ONLY THE VEHICLES USED AND MISSIONS PERFORMED-

	TOT. VEH-HRS	PERCENT	AVER/MISSION
TRAVEL	13.1	3.0	.82
DELAY (DEPT. POINT)	0.0	0.0	0.00
DELAY (INTERM. POINT)	0.0	0.0	0.00
DELAY (RTN POINT)	6.8	1.5	.42
LOADING	.3	.1	.02
UNLOADING	5.0	1.1	.31
IDLE	415.4	94.3	25.96

HRS FROM FIRST DEPARTURE AND LAST DESIRED ARRIVAL= 73.42

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         OUTPUT FOR POOL NO.          5
         VEHICLE NUMBER              10
         VEHICLE PAYLOAD (STX10)     20
         VEHICLE CUBIC CAPACITY     500
         NO. OF VEHICLES IN POOL      5

                  NO MISSIONS ASSIGNED

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APPENDIX E

GLOSSARY OF VARIABLES IN MAIN PROGRAM

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Glossary Of Variables In Main Program

A	Array for missions information.
BT	Amount of the capacity of a vehicle required to haul the cargo for a given mission.
B5	Number of tons of the mission cargo that the pool can haul with the vehicles available.
B6	Number of cubic feet of the mission cargo that the pool can haul with the vehicles available.
D	Array for temporary storage of information on missions that are to be transferred.
E	Array containing event times relative to the missions. Contains mission dispatch time and the time vehicles will be available for subsequent missions.
F	Auxiliary array containing the number of minutes required to accomplish each mission and the number of vehicles required to haul the mission cargo (multiplied by 100).
FK	An auxiliary parameter that stores the value of the index KK in floating point form.
F1 F2 F3 F4 F5	Auxiliary parameters used for storage and accumulation of certain mission statistics.
G	Array used to store mission statistics for reporting according to the proper mission disposition.
I	Loop index.
IP	Index used in the storage of information on missions that are to be transferred.
IPLOT	Control integer for plotting of simulation results.
ISP	Control integer for modifying, en masse, mission splitting parameters.
I1 I2 I3	Indices used in storage of mission statistics in G array.

I7	Index used in storage of vehicle availability information in E array and storage of information on transferred missions in A array.
I8	Integer form of mission disposition code.
J	Auxiliary index used to reference information in various arrays.
K	Index for referencing information in various arrays with respect to pool number.
KK	Index used in referencing pools for the transferal of missions.
K1	Auxiliary index used to determine the number of originally assigned missions and the number of links input for each pool.
L	Index used to reference information in various arrays with respect to links.
LIST	Control parameter for printing input information for each pool.
L1	Auxiliary index that is used in storing information on the remainder of split missions.
MAXP	Control parameter for the maximum number of pools that can be simulated.
MCA	Control parameter indicating the number of columns in the A array.
MCG	Control parameter indicating the number of columns in the G array.
MCT	Control parameter indicating the number of columns in the T array.
MLINK	Control parameter for the maximum number of links for each pool.
MMISS	Control parameter for the maximum number of missions for each pool.
MRG	Control parameter for the number of rows in the G array.
NA	Auxiliary index for referencing the proper row in the E array.

NB	Auxiliary index for referencing the proper row in the E array.
NL	The number of links for a pool.
NM	The number of missions assigned to a pool.
NN	Control index for the number of missions to be transferred out of a pool.
NPOOLS	The number of pools being simulated.
NTRANS	The total number of missions to be transferred out of a pool.
NY	Auxiliary index used to reference the proper rows of various arrays.
NZ	Auxiliary index which indicates the total number of missions that are assigned to a pool. It is incremented by one each time a mission is split.
NZ3	Auxiliary index that is used to keep track of the maximum number of vehicles used in a pool.
NZ7	Auxiliary parameter that is used to control program flow.
O	Array that is used to store information on the remainders of split missions.
P	Array that is used to store the characteristics of each pool and other bits of information pertaining to each pool.
Q	Array that is used to store the information on vehicle status for the pools.
T	Array that is used to store the information on the links for the pools.
TEMP	Auxiliary variable that is used for temporary storage.
T7	Auxiliary variable that is used to indicate the pool to which missions are to be transferred.
ZT	The number of vehicles on-hand in a pool.
Z5	The number of vehicles occupied on a mission multiplied by 100.

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APPENDIX F

IDENTIFICATION OF ENTRIES IN VARIOUS ARRAYS

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Variables In Array P(15,10)

P(1,K) - Pool identification number of the K-th pool.

P(2,K) - Vehicle type identification number.

P(3,K) - Vehicle payload, in short tons X 10.

P(4,K) - Vehicle capacity, in cubic feet.

P(5,K) - Number of vehicles assigned to the pool.

P(6,K) - Number of links or routes for the pool.

P(7,K) - Number of missions assigned to the pool.

P(8,K) - Number of vehicles occupied performing missions.

P(9,K) - Earliest vehicle dispatch time.

P(10,K) - Latest desired vehicle availability time.

P(11,K) - Number of missions to be transferred out of the pool.

P(12,K) - Unused

P(13,K) - Unused

P(14,K) - Unused

P(15,K) - Unused

Variable ISP

Controls the splitting parameter for all missions.

ISP = - 1	All missions will be permitted to be split when necessary.
ISP = 0	Missions retain their assigned values of the splitting parameter.
ISP = 1	Missions will not be permitted to be split.

Mission Disposition Code

The TVEM controls the accumulation and reporting of mission statistics by disposition category in the Mission Status Report through the assignment of a code value to each mission during the simulation of a vehicle pool. The assignment of the code also facilitates the proper handling of missions that have been transferred. At the initial assignment of missions, the model uses the splitting parameter as the code. If the mission is not completed in full, the code value is changed to indicate its disposition, i.e., split, transferred, etc.

The array element A(I,8,K) contains the code value for the I-th mission assigned to the K-th pool. The list of code values and their associated meanings follows:

List of Mission Disposition Codes

Original Missions:

1 - Mission completed in full. Splitting was permissible.

2 - Mission completed in full. Splitting was not permissible.

3 - Mission completed in part.

4 - Mission transferred in part. Remainder of a mission completed in part (Code 3).

6 - Mission transferred in full. Even though splitting was permissible, no vehicles were available.

7 - Mission skipped in full. Transfer was not permissible and, even though splitting was permissible, no vehicles were available.

8 - Mission transferred in full. Splitting was not permissible.

9 - Mission skipped in full. Neither splitting nor transfer was permissible.

25 - Mission skipped in part. Remainder of a mission completed in part (Code 3) that could not be transferred (as in Code 4).

Additional Missions:

10 - Fractional mission completed (from Code 4).

11 - Fractional mission skipped (from Code 4). Not enough vehicles were available and the mission will not be further split (in the current version of the model.)

12 - Mission completed in full (from Code 6).

13 - Mission skipped in full (from Code 6). Even though splitting was permissible, no vehicles were available and further transfer was not permissible.

14 - Mission completed in full (from Code 8).

15 - Mission skipped in full (from Code 8). Neither splitting nor further transfer was permissible.

16 - Mission completed in part (from Code 6).

*17 - Mission further transferred in part (from Code 6). Remainder of a mission completed in part (Code 16).

*19 - Mission further transferred in full (from Code 6). Even though splitting was permissible, no vehicles were available.

*21 - Mission further transferred in full (from Code 8).

24 - Mission skipped in part (from Code 6). Remainder of a mission completed in part (Code 16) that could not be transferred in part (as in Code 17).

* Codes 17, 19, and 21 are not in use. In the current version of the model, additional missions are prevented from transferal to yet another pool by line 530 (A(I7, 7, KK) = Ø). Instead, such missions will be skipped, as in Codes 24, 13, and 15 respectively.

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